THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVII. No. 676.] LONDON, APRIL 25, 1876. [28TH YEAR.] Price 6d.

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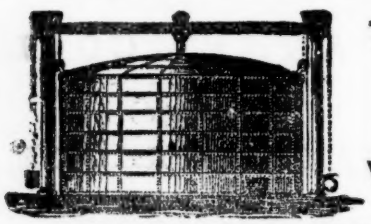

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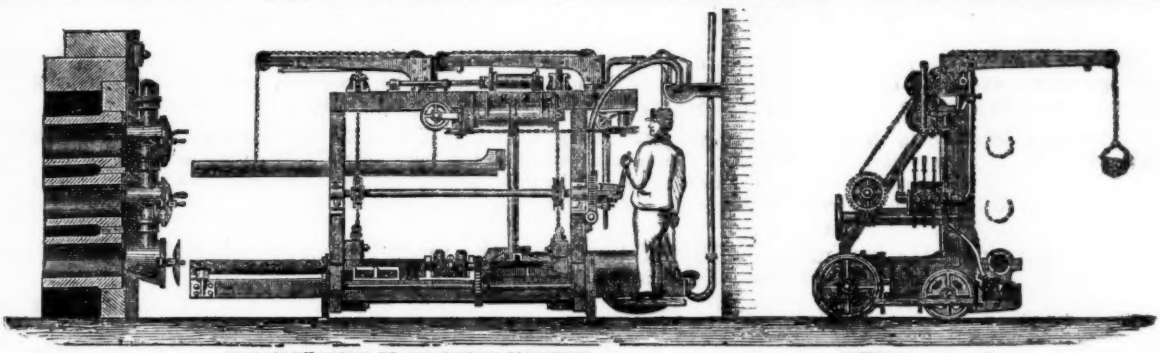

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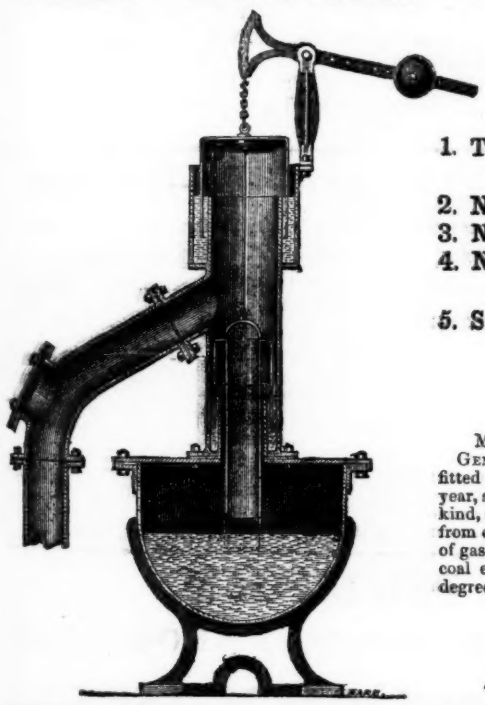

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TESTIMONIAL.

Tenby Gas-Works, March 29, 1876.

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(Signed) EDMUND H. STEVENSON.

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The Company also manufacture Dry Meters upon the most improved principle, and all their Meters being made to standard gauges, the most accurate measurement is obtained.

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The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

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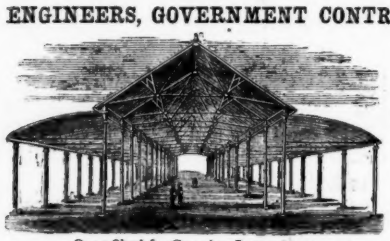

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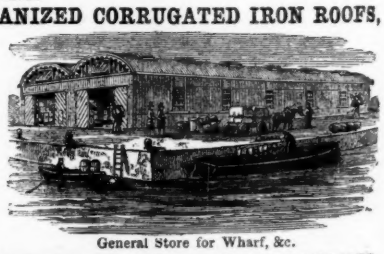

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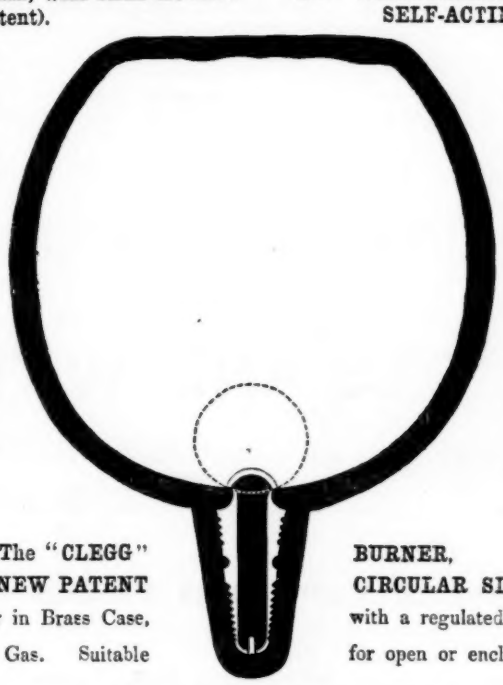
This Burner has been pronounced by the most eminent Engineers of the day to be the perfection of a flat-flame Burner.

The Shades, which are made in a beautiful white glass called Albatrine, are manufactured *exclusively* for these Burners, and cannot be obtained elsewhere.

The light emitted from this Burner is very white and soft to the eyes, and is about 30 PER CENT. superior to the ordinary fishtail.

Numerous other pattern Shades, Plain or Ornamental, may be obtained with these Burners.



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RETORT-LIDS,

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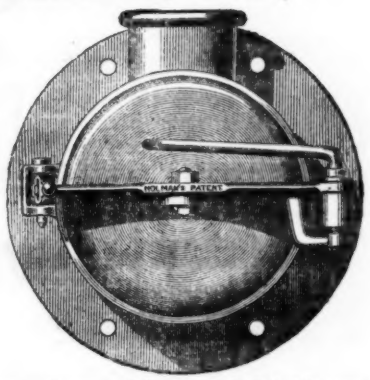
BRACKETED CROSS-BARS,

Anti-Friction Catches and Eccentric Fastenings.



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Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested (rigid cast iron is now successfully employed), nearly 20,000 being in use at various Gas-Works in London and the Provinces, among which may be mentioned:—

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" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

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" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
" Manchester Corporation do.
" Salford do. do.
" Rochdale do. do.
" Liverpool Gas-Works.
" Birmingham do.
" Birkenhead do.
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" Rotherham do.
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" Aberdare do.
" Ballymena do.
" Richmond do.
" Stalybridge do.
" Longton do.
" Exeter do.
" Ross do.
" Falmouth do.
" Barrow-in-Furness do.
" Belfast do.
" Wakefield do.
And other Provincial and Foreign Gas-Works.

IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them.

I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly, (Signed) G. C. TREWBY.

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PATENT

THREE-CYLINDER ENGINE,

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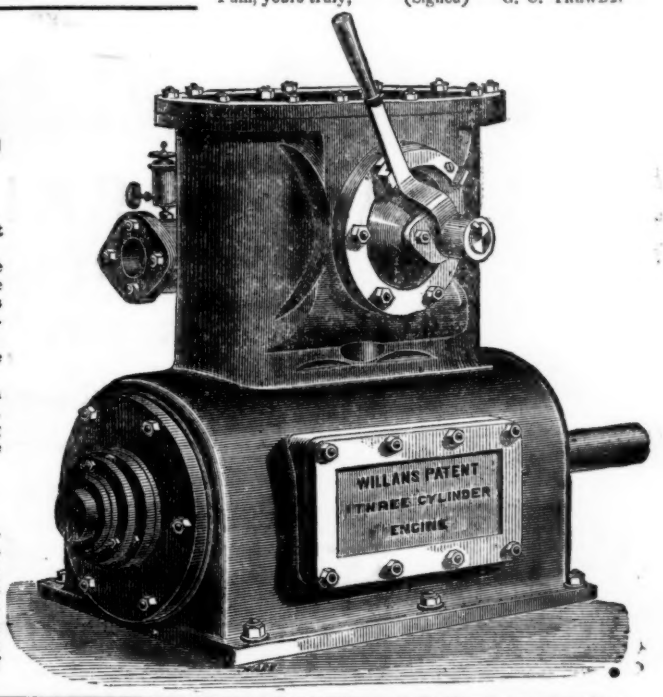

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Breadth . . . . . "	12	15	20	22	27	34
Height . . . . . "	19	20	29	40	42	56
Weight of Engine complete. . . . . cwt.	2½	3½	8	9	16½	31
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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, APRIL 25, 1876.

Circular to Gas Companies.

We have nothing to report, this week, as to any progress made towards the settlement of metropolitan gas affairs, and it now seems improbable that anything will be done before the ninth of next month. The Regulations Bill stands on the paper of the House of Commons for a second reading on the evening of that day. Much will depend on the result. If the Bill should be read a second time, another Committee seems to us inevitable, since the companies, who are now unwillingly concerned with fresh legislation, cannot accept, without protest, worse terms than were inflicted on the Commercial Company by Mr. Forster's Committee last year. The Bill of the South Metropolitan Company, that of the Chartered Company, and the Regulations Bill, will, of course, be referred to the same Committee, and we may witness a sort of "triangular duel." The Chartered Company, having agreed to accept auction clauses, they must be inserted in the Regulations Bill. But the South Metropolitan Company object to them, and so, most decidedly, do the three other companies who are now the proposed victims of aggressive legislation. We can only wait with patience, and see what will come of the present muddle. So far as we know, the South Metropolitan Company have not resolved on the course they will pursue; but there can hardly be a doubt that they will withdraw their Bill, for to them the auction clauses must be particularly obnoxious. They have, of their own free will and mere motion, sunk capital, to the amount of £80,000, on which they neither ask nor receive any interest. The only chance the proprietors have, for recouping this loss, is by way of premiums on newly-issued capital, and those are now denied them; and we consider they are right in protesting against the injustice the Regulations Bill will inflict —the more so if a low standard or initial price be fixed. We are constrained, however, to leave a further consideration of the matter to a future time.

We report to-day the proceedings at the final half-yearly meeting of the Independent Gas Company, whose last accounts offer some gratifying features. Financially, the affairs of the company became merged in the Chartered on the 1st of January, and the company have now ceased to have a separate existence. The price of gas in their district up to the time of the combination was 3s. 6d. per 1000 feet; but we may assume that it will now be raised to 3s. 9d. The Chartered Company, it will be seen, gain a reserve-fund amounting to £25,500, as well as a freehold property, and the shareholders in the Independent are guaranteed a preference dividend of ten per cent., without being in any way affected by the sliding scale. There is nothing to be complained of in this arrangement. The district of the late Independent Company may be said to be used up. There was but little chance of any extension of trade; and the proprietors may be congratulated on having got rid of a concern which, by itself, had no future. They might have gone on earning maximum dividends, and accumulating a reserve-fund, and soon the consumers in Shoreditch and the neighbourhood would have been as well off as those in Camberwell. But it has been ordained otherwise, and Shoreditch must now pay 3s. 9d. There is a moral in the story which we hardly care to point. "Put not your trust in Princes," was said years ago. To-day it may be said to gas consumers, "Put "not your trust in the Metropolitan Board of Works."

We give, in this issue, a tolerably full abstract of a paper read to the Statistical Society by Mr. H. Chubb, "On the Supply of "Gas to the Metropolis." The subject is of immense interest. It might have been treated historically, from an engineering or from a financial point of view, or it might have been considered from the standpoint of to-day, with especial reference to the consequences of the proposed new legislation. It would have been difficult, if not impossible, to have combined all those methods of treatment in a paper of moderate length. We feel bound to say, however, that Mr. Chubb's paper has greatly disappointed us. We expected much more of the author. Our readers have been made well acquainted with the history of the development of the gas industry in the Metropolis, in the earlier part of the "Treatise," &c., we have still in course of publication. We have not, however, gone much into the financial history of the Metropolitan Gas undertakings, for reasons which may be readily guessed. With the dealings of Parliament and the various local authorities, in regard to the gas companies, our paper has been filled from week to week. On no one of the points mentioned can Mr. Chubb be said to give us any new or original information. The *résumé* of history is not, however, without value, since it will be disseminated in a popular form, and not be confined to an exclusive journal like our own. We need not stop to point out what is wanting in the earlier history of gas enterprise; but may pass on to the author's remarks on the evils of the competitive system, as it existed prior to 1856. These were enormous; and we may say, that the public authorities readily acquiesced in the districting arrangements. The Act of 1860 followed, and Mr. Chubb sets out, at some length, the obligations which that Act imposed on the gas companies. He does not, however, say that, owing to the supineness of the authorities, the Act has never really been put in force. It compelled the supply of twelve-candle gas; and we may agree with one speaker at the Statistical Society's meeting, so far as to express an opinion, that the gas supplied in 1860 was as good (or it may be better), so far as regards illuminating power, as that supplied to-day. The Act of 1860 also laid down a standard of purity, which may be said to be just the same as is fixed at present. Probably, the obligations of the Act were never fulfilled, except as regarded the illuminating power of the gas; but only one authority (the Corporation of London) ever took proceedings, under the Act, against a company, for an excess of sulphur impurity, and those broke down on a technical point. One company went so far as to publish a report from their chemical adviser, showing that the maximum amount of sulphur in their gas was nine grains per 100 cubic feet. We tested the gas immediately afterwards, for our own information, and found *fifty-nine* grains, but the local authority had never appointed an Examiner; or, at all events, no one competent to make an examination. So with the obligation to keep and publish accounts, on which Mr. Chubb lays some stress. The Act was, in this respect, a perfect failure. It did not prevent one company from disposing of, and distributing, a "contingency-fund" as back dividends; nor did it, more recently, prevent a company from placing the deposit-money, paid on land purchased, to "wear and tear" account. We, who have upheld —and, indeed, still uphold—the principles of the Act of 1860, have a right to point out these infringements of that measure, which we regard as one of the most just ever passed by Parliament. That it required amendment, events have sufficiently shown, and we have indicated the direction in which amendments should be sought; but we still contend, that the *principles* of the Act of 1860, properly applied, afford the best guarantee to a gas company, and the best protection to a gas consumer.

We cannot, to-day, follow Mr. Chubb over all the ground he traversed. We shall return to his paper; but we cannot help expressing a regret that he did not deal with the prospects of gas proprietors, as they are revealed to us to-day. He is now a director of the largest gas undertaking in the world, which will soon be subjected to terms unprecedented in the history of gas enterprise, and we should have been glad to have his views as to

the future. But we have to leave him to-day, and must consider his opinions on the more modern legislation, next week. The discussion on Mr. Chubb's paper calls for some comment, but this we are compelled to defer.

The report of the last half-yearly meeting of the Sheffield United Gas Company, which will be found in another column, is of considerable interest. By the Sheffield Gas Act, 1866, the company were granted an upward sliding scale of dividend for the additional capital authorized by the Act. Power was given to raise £350,000, but no maximum price was fixed for the gas. It was arranged, however, in committee, before whom the opponents of the company were well represented, that so long as more than 3s. 3d. per 1000 was charged, the dividends on this new capital should not exceed seven and a half per cent.; if 3s. were charged, the dividend might be raised to nine per cent., and if the price were reduced to 2s. 9d., a dividend of ten per cent. might be paid. Beyond this they have no power to go: ten per cent. is the maximum on all classes of shares. This, as we have said, was arranged without the interference or opposition of the company. So likewise was the minimum illuminating power of the gas, which the committee fixed at fifteen candles. Their previous Act compelled the company to supply only ten and a half candle gas; but it was proved before the Referees that sixteen-candle gas had actually been supplied. The Sheffield Gas Company have been a good deal persecuted, and we notice these facts, because we fancy we see indications that another attack will shortly be made upon them. It must be remembered, to the credit and honour of the company, that they did not raise the price of gas during the coal famine. To-day they find themselves in a position to make a reduction, which will bring their sliding scale into operation. The price for the present half year will be 3s., which entitles the holders of the new capital to nine per cent., if it can be earned. If, however, a small deficiency should be found, the ample reserve-fund of the company will allow it to be made up. We hope that all the anticipations of the Chairman will be realized, He admits that his calculations are based on the present price of coal, which he, as we do, considers to have reached a minimum rate. Any change, in our opinion, must be in an upward direction, and, looking at the fearful depression of trade, which has produced the present low price, we are most anxious to see a revival, and a return to high rates. It will come, we feel confident; and with it difficulties for gas companies.

A question may arise here, Which is the better for a gas company and gas consumers—the sliding scale, such as the Sheffield Company have; or the scale imposed on, or adopted by, some Metropolitan Gas Companies? We, considering equally the interests of both, have no hesitation in expressing an opinion in favour of the Sheffield system. In the interest of gas proprietors, we ask, in the language of the late Mr. Stewart, of New York, for "ten "per cent. and no lies." We are old-fashioned enough to adhere strongly to the belief that any profit beyond ten per cent. ought to belong to the consumer, as it does under the Sheffield Act.

It is difficult to foretell the future of gas business in this Metropolis; but, taking things in their most favourable aspect, as they stand at present, it would seem clear that 3s. 6d. will be the minimum price over by far the greater part of London, for, say, the next two years. In Sheffield, such a price would only give the proprietors of the new capital seven and a half per cent.; in London, it will give them ten and three-quarters!!

The interesting lecture delivered by Mr. Vernon Harcourt, at the Society of Arts, will be read with pleasure. The lecturer has thoroughly identified himself with gas interests, regarded from a scientific point of view; and his appointment as a Referee has always been a source of satisfaction to us. His arrangement of a "sulphur test" may take its place beside the jet photometer, as a guide to a manager. Mr. Harcourt's proposed method of estimating the illuminating power of gas is, we fear, a display of mistaken ingenuity. By all means, let us have a rigidly exact method, if we can; but how can it be obtained, unless by Mr. Crookes's torsion balance? To our minds, Mr. Harcourt's standard gas is open to all the objections made to standard candles. We question whether any number of fractional distillations will give us "pentane" and "hexane" in a constant state of purity, and very small variations in their proportions will alter the illuminating power of the standard gas. So it comes to this, that every sample of standard gas must be "standardized." And how? By a comparison with standard candles. Well, it seems to us, that we may just as well go on with candles, and save ourselves a world of trouble. There is another point, to which Mr. Harcourt should give some attention. Supposing the coal gas, under examination, not to equal the sixteen-candle standard gas, how is the actual value of the former to be determined? A gas company is subject to a heavy fine for a deficiency of half a candle, and it would be necessary to express exactly the actual amount of deficiency. Candles, we know, are open to many objections; but their employment is made compulsory by all gas Acts, and we do not see how it can be abolished. Will Mr. Harcourt draw us a clause, for insertion in the Regulations Bill, defining the quality of gas to be supplied to the Metropolis, as estimated by his "standard" gas, and describing in what way penalties for deficiency are to be assessed? That may give the method a practical turn, which will commend it to further notice. But we shall still believe that properly-made candles, in the hands of skilled and careful operators, offer the best means of estimating the illuminating power of a gas. Scientific refinements are out of the question in such a matter as the photometric valuation of a gas. We want a rough-and-ready method, easy of application, the results of which can be expressed in definite and intelligible terms, and such a method is afforded us by the use of candles.

Simultaneously with the appearance in London papers of an advertisement announcing the proposed winding up of the company formed here to work Gramme's Magneto-electric machine, comes news from Paris of the successful application of the machine to the illumination of a large goods-shed at a station on the Great Northern Railway of France. We feel bound to communicate the information for the edification of the many who entertain a firm belief that the electric light will some day supersede gas. These will not be disconcerted by the announcement that a three-horse power steam-engine is required to drive a machine capable of supplying light to replace that furnished by forty gas-jets. At this rate the light cannot be cheap; but we shall look with some interest for further developments of the capabilities of the machine, of which, however, it is probable that we shall hear no more.

We have received, too late for publication this week, a report of proceedings taken by the Exeter Town Council, on Friday last, against the Gas Company, for an alleged nuisance in allowing the escape of noxious effluvium from their works. It was shown, in evidence, that the various factories on the river were much more likely to be the cause of the offensive smells, which are undoubtedly perceptible in the locality, and, after hearing several scientific witnesses as to the mode in which the gas-works are conducted, the Bench dismissed the summons against the company. We shall publish the report next week.

Water and Sanitary Notes.

The first application of the Artizans Dwellings Act in this Metropolis is likely to be made in the districts of Whitechapel and Limehouse. If the operation of the Act be required anywhere, it is certainly in the districts named, the condition of which cannot be conceived by any one who has not actually visited the spot. It is now universally admitted that, all things being equal, the rate of mortality increases with the density of population, and as these are some of the most densely-populated districts in the Metropolis, it follows that the rate of mortality must be the highest. From the evidence of one of the medical officers, it would appear that the death-rate in one portion of the condemned districts is no less than 59 per 1000, as against 25 per 1000 in the whole Metropolis. This is a state of things which a civilized community cannot afford to pass over. There is, however, a difficulty in providing an effectual remedy. The projected alterations will displace 4350 inhabitatants, who must herd somewhere until habitations are built, which will only accommodate 3600 people; and when all is done, the actual superficial area provided for each person will be only four square yards. It must be understood, that this calculation relates to the houses only. There will be wide streets, and some open spaces, which will afford breathing room. The houses to be built will be five storeys high. We are continually expecting to see some medical gentleman, anxious to create a sensation, denouncing these high erections. To a man with a weak heart, returning home, tired, after a long day's work, the ascent of five flights of steps must be fatiguing and distressing. Many other objections to these enormous structures occur to us; but there is no use in stating them. We live in an age of transition, and every reasonable thing must have a trial. Of one thing we are certain, that the improvements now promoted by the Metropolitan Board of Works must prove beneficial, and we hope that no time will be lost in carrying them out.

The Southwark and Vauxhall Water Company have withdrawn from further proceedings against the Richmond Vestry, who have obtained a loan of £28,000 from the Public Works Loan Commissioners, and are now free to go on with their well. Nothing has yet been settled, as regards the distributing plant of the company in possession, which, we may suppose, the vestry will eventually take over; and we presume that the Southwark and Vauxhall Company will continue to supply the town and district, until the vestry are prepared to assume the responsibility.

There is, of course, the possibility of competition, which might give rise to many complications.

The Company of Proprietors of the Birmingham Water-Works Company meet to-morrow, for the last time, to settle the distribution of £3022 received from the Corporation of Birmingham. We ought to say that, in order facilitate the winding up of the company, it has been registered under the Companies Act, 1862, and that the chairman has been appointed liquidator. The sum named above will pay the expenses of the company incurred since the 1st of January, and the costs of winding up, and there will then remain a sum in hand, which it is proposed to distribute among the officers and the servants of the company.

A scheme for the disposal of Slough sewage involved the institution of a sewage farm within half a mile of Windsor Castle. The Commissioners of Woods and Forests determined to oppose the scheme on the part of the Crown, and it has consequently been abandoned. Thus much, then, seems to be settled. A sewage farm cannot be laid out within half a mile of a Royal residence.

In our last "Notes," we referred to the recently presented Report of the Water Committee of the Town Council of Liverpool, showing their reasons for recommending the Corporation to adopt the Windermere scheme. We now present a full abstract of that report, which has an interest for readers outside Liverpool. We do not, as yet, know whether the Corporation of Manchester will join in the execution of the scheme, but, to our minds, it is certain that, if it should be carried out, several towns in the North will claim to share the advantages.

The committee commence their report by stating that the points which came under their consideration were:—1. What will be the requirements of the district for which the corporation are responsible, at the earliest date at which a new supply can be obtained, and the prospective requirements for a reasonable period beyond that date? 2. What is the present and prospective supply available from existing sources? 3. Assuming a further supply to be necessary, can such supply be most advantageously obtained (*a*) by purchasing a portion of the water now given as compensation? (*b*) by sinking additional wells? or (*c*) by an impounding scheme? 4. Assuming a supply by an impounding scheme to be preferable, which of the schemes investigated, having regard to the foregoing considerations, may be most advantageously adopted? 5. In what way can the cost of the works be provided?

In addition to the advice of their own officers, they secured the assistance and counsel of Mr. Thomas Hawksley, C.E., Mr. John Frederic Bateman, C.E., F.R.S., Mr. James Glaisher, F.R.S., and Mr. Joseph Jackson, C.E.; and in their report they state that, after much deliberation, they have come to the conclusion that any new scheme to be promoted by the council should be sufficient to provide for at least 30 years from this time.

The requirements of the district for all purposes, at the earliest date at which a new supply can be obtained, and the prospective further requirements up to the year 1905, are estimated in round numbers as follows:—

Year.	Gallons per Day.	Gallons per Week.
1885	20,100,000	140,700,000
1890	22,850,000	159,950,000
1900	28,850,000	201,950,000
1905	32,400,000	226,800,000

The borough and water engineer has carefully investigated the question, with the benefit of the assistance which previous reports give; and he estimates the yield from Rivington, after the new Yarrow reservoir has been completed and filled, at 11,932,069 gallons per day, equal to 83,524,483 gallons per week.

After revising his calculations, so as to make them applicable to the year 1885, and assuming the decrease in yield to continue as heretofore, the borough and water engineer is of opinion that in that year the daily yield from the wells will not exceed, in round numbers, five million gallons per day, equal to 35 million gallons per week, and that this quantity will continue to decrease after that date.

Taking the yield from Rivington and the wells together, the available quantity in 1885 will therefore be 17 millions of gallons per day (12 by 5) equal to 119 (84 by 35) millions per week. This shows a deficiency of 3,100,000 gallons per day, equal to 21,700,000 gallons per week in 1885.

Disregarding any decrease in the produce of the wells subsequently to 1885, the deficiency in 1890 and 1905 will be as follows:—In 1890, 5,850,000 per day, 40,950,000 per week; in 1905, 15,400,000 per day, 107,800,000 per week.

The committee consider that there is not now any reasonable prospect of making an arrangement for the purchase of the Yarrow compensation water on advantageous terms. They cannot, therefore, recommend the council to attempt to obtain a further supply by the purchase of compensation water.

With regard to the well question, the conclusions to which the committee have come on this point are as follows:—1. That the present rate of pumping is gradually lowering the level, increasing the hardness, and reducing the quantity of water in all the wells of the corporation. 2. That any attempt to obtain more water by additional pumping from any one of the public wells will not only lower the level, and reduce the quantity in that particular well more rapidly than it is being lowered at present, but will also increase the rate of reduction in the other wells. 3. That, inasmuch as further sinking or boring at the existing wells is shown, by operations which have from time to time been carried out, to have a constantly diminishing productive effect, it is evident that the area drained by the wells is being gradually exhausted of its surplus store of water, and that the annual infiltration from the surface is not sufficient to restore the normal level. 4. That, having regard to the limited area of the sandstone formation around Liverpool, there are not a sufficient number of sites for wells from which the committee could hope to obtain a supply of water sufficient to satisfy the requirements up to the year 1890.

The relative merits of the schemes for obtaining water from sheds or lakes are then dealt with. These schemes are the Bleasdale, the Ullswater, and the Windermere. The latter is recommended for adoption. Its cost, as estimated by Mr. Jackson, ranges from £1,782,023, for a supply of 10 million gallons per day, to £4,315,801 for a supply of 40 million gallons per day.

The relative merits and disadvantages of this scheme are—1. That there is practically an inexaustible supply of water, the gathering-ground extending to 60,000 acres, as compared with 36,000 acres at Ullswater, 7642 acres in Bleasdale, and 10,500 acres in Wyredale, the latter being subject to reduction as already explained. 2. The water rights on the river Leven flowing out of the lake are of comparatively small value, and may be purchased at a reasonable sum. 3. The quality of the water is soft, bright, and colourless, and equal to that of Ullswater, and the distance from Liverpool is only 67 miles, as compared with 100 from Ullswater. 4. There are no serious engineering difficulties, and the works could be completed in a less time than either the Bleasdale or Ullswater scheme. 5. From the very large area and capacity of the lake, it will not be necessary to raise the level of the water more than three feet, and appliances can be provided by which extraordinary floods, such as at present occur, will be got rid of. 6. One of the disadvantages of the scheme, as compared with Bleasdale and Ullswater, is the cost of pumping the water, involving a permanent annual charge; but, on the other hand, this expense will be incurred only as the wants of the town increase. 7. Another drawback is the sewerage from the houses on the margin of the lake, and of the lakes and streams discharging into Windermere. There is a considerable and increasing population in the district, and it has therefore been necessary to include in the estimates the cost of works for keeping all the sewage out of the lakes; but the tendency of modern legislation is to increase the power of preventing the fouling of water, and the local authorities may, no doubt, be induced or compelled to bear the whole or a considerable portion of this cost.

In arriving at the amount required for the Windermere scheme, the committee have adopted the estimate of Mr. Jackson, as amended by a sub-committee (including only the cost of such engines and buildings as will be required upon the first introduction of the water). To this sum they have added £25,000 for the cost of obtaining an Act of Parliament and for legal and engineering expenses, making the total amount required for the proposed works £1,459,588. This does not, of course, include the capitalization of the cost of pumping, which will be a charge on revenue.

The present water-works debt amounts to £2,268,693 (the depreciation-fund being £103,113), making, with the sum of £1,459,588 above mentioned, a total debt in the year 1885 of £3,728,281, the interest upon which, taking the average rate now paid (4·18 per cent.) on the existing debt, and 4½ per cent. on the new debt, will be £156,858.

In 1885 the expenditure will be as follows:—

Interest on £3,728,281.	£156,858
Working expenses	94,699
Depreciation fund on existing debt, estimated	5,000
Sinking fund on new debt, £1,459,588, at ½ per cent.	7,297
Total.	£263,854

It will therefore be seen that the domestic water-rent will require to be increased. The present rent is 6d. in the pound in the borough, and 9d. outside. The maximum poundage rents are 1s. and 1s. 3d., which would in the year 1885 raise £288,892; showing that if the maximum domestic water-rents are levied there will be a surplus of £25,038 per annum. It is, therefore, clear that without any alteration of the power of levying the water-rate or water-rents, there is no doubt as to the corporation having ample means to meet the interest upon the new capital to be raised and any sinking-fund which Parliament may require.

The Acts now in force as to the water-rate and domestic water-rent do, however, require some amendment, without which the committee feel that it would be most unreasonable and unjust to expect the owners and ratepayers of property in Liverpool to provide any new scheme for water supply, as the necessity arises from the increased demand in the out-townships.

The committee submit to the council the following conclusions:

1. That the available water supply for the borough and district when the Yarrow reservoir is completed and in use (that is, filled with water) will be 17¾ millions of gallons per day, equal to 124 millions of gallons per week, diminishing to 17 millions of gallons per day, equal to 119 millions of gallons per week, in the year 1885.

2. That the estimated present and prospective requirements of the district for domestic use, and for shipping and manufacturing purposes, are as follows:—In 1875—actual average delivery—17,285,196 gallons per day, equal to 120,996,370 gallons per week; in 1885—estimated requirements—20,100,000 gallons per day, equal to 140,700,000 per week; in 1890, 22,850,000 gallons per day, equal to 159,950,000 per week; in 1905, 32,400,000 gallons per day, equal to 226,800,000 per week.

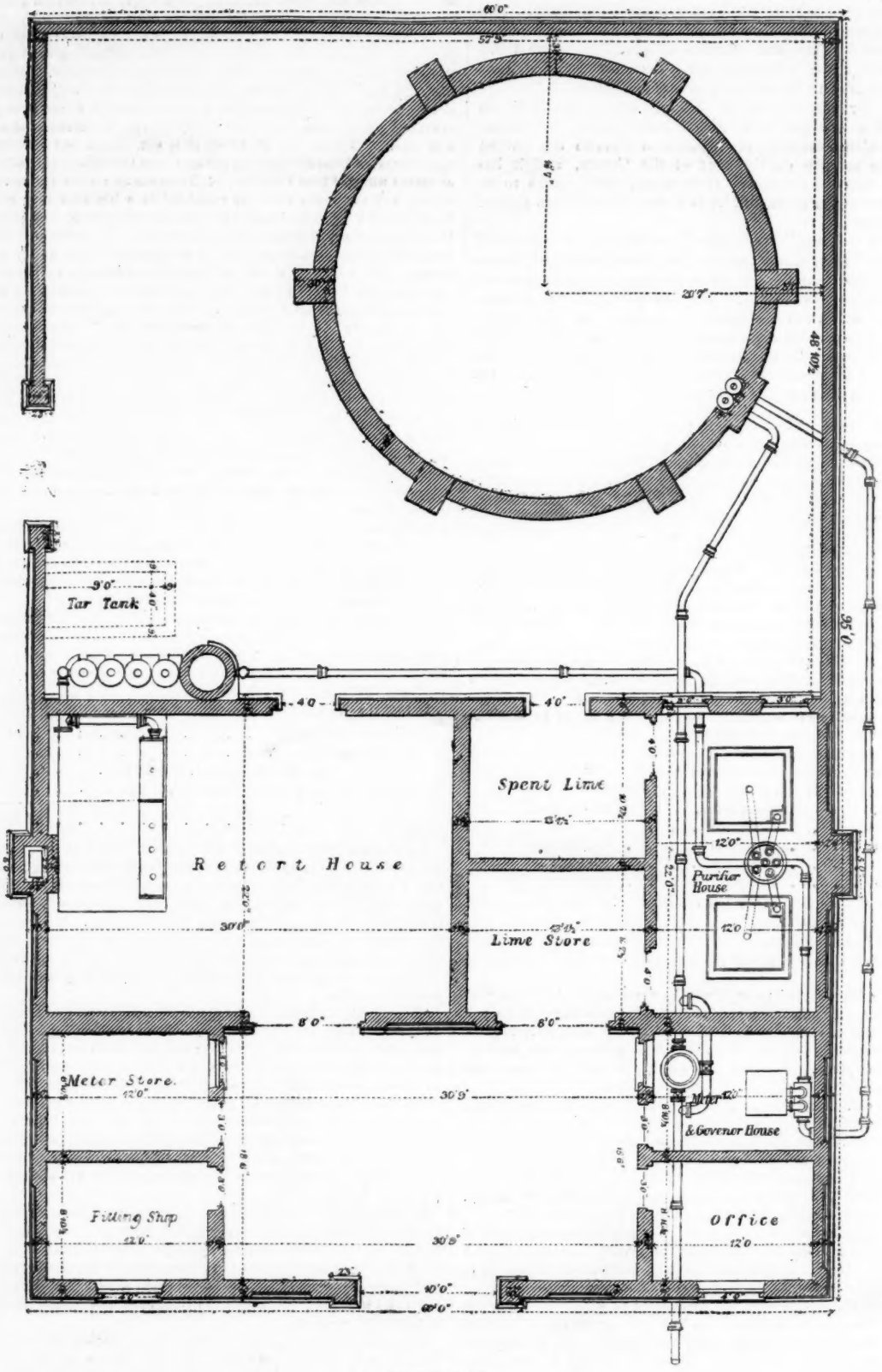
3. The committee recommend an application to Parliament in the session of 1877, for an Act to authorize the corporation to take a supply of water from Windermere Lake, and to borrow the estimated amount required for that purpose.

4. That there be included in the same application to Parliament, powers to increase the addition to the domestic water-rent outside the borough from 1¼ to 2½ per cent.; to consolidate the mortgage debt on the water-works; to prevent the pollution of water in the corporation wells; and such amendments in the Water-Works Acts in matters of detail as to the council may appear advisable.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

XCII.

Designs for Small Works.



Ground Plan.

The subject of our illustrations this week is a small gas-work, recently completed in the village of Snitterfield, Warwickshire, from designs prepared by Mr. R. Dempster, of Elland, who also superintended the erection. It is given as a good specimen of this class of structure in cases where the engineer is not restricted too closely in expenditure, and where, from the situation, it is desirable to render the works as sightly as possible.

The owner of the property in the locality is Mr. R. N. Phillips, M.P., who has had the whole of the works constructed at his own expense for the benefit of the tenants on his large estate. The site is the lower part of the village, close to a stream of water, and one of the principal features in the design is the neat and, in fact, ornamental character of the buildings and erections. There is no shaft or ventilator, as in most other works; the roof has rather a high pitch, and the chimney is carried up in the gable wall as an ordinary chimney, but is lined with fire-bricks to the top, and is of rather larger dimensions than a

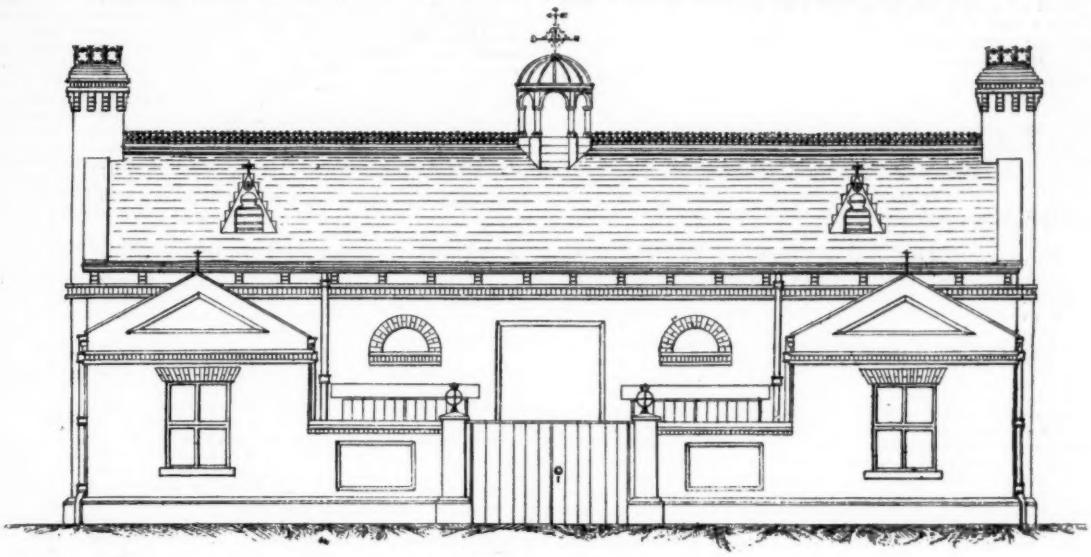
house chimney. The unsightliness of many small works is avoided in this design. The ornamental ventilator in the roof is substituted for the ordinary arrangement, and there is a weather damper inside, worked by hand at pleasure.

The retorts are capable of producing 12,000 cubic feet of gas per day, and there is a corresponding storeage capacity. The works, including mains and meters, have been provided at a cost of about £1800.

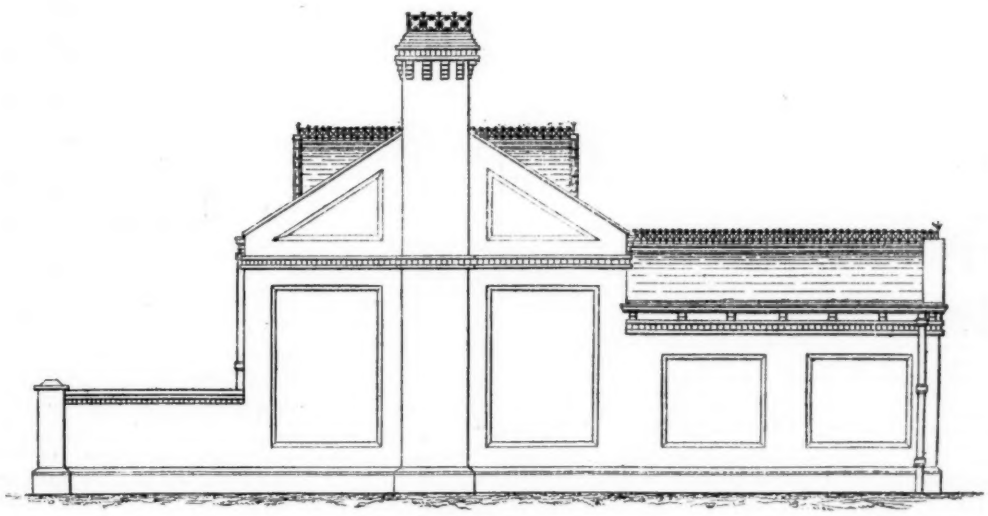
By arranging the tar-tank and spent lime shed at the back of the works, the engineer has made suitable provision for the front yard being kept clean, a desideratum not always secured in country works.

The proprietor, Mr. Phillips, has had a walk planted with shrubs and trees along the front of the works, which adds much to the general neatness and pleasing character of the whole establishment.

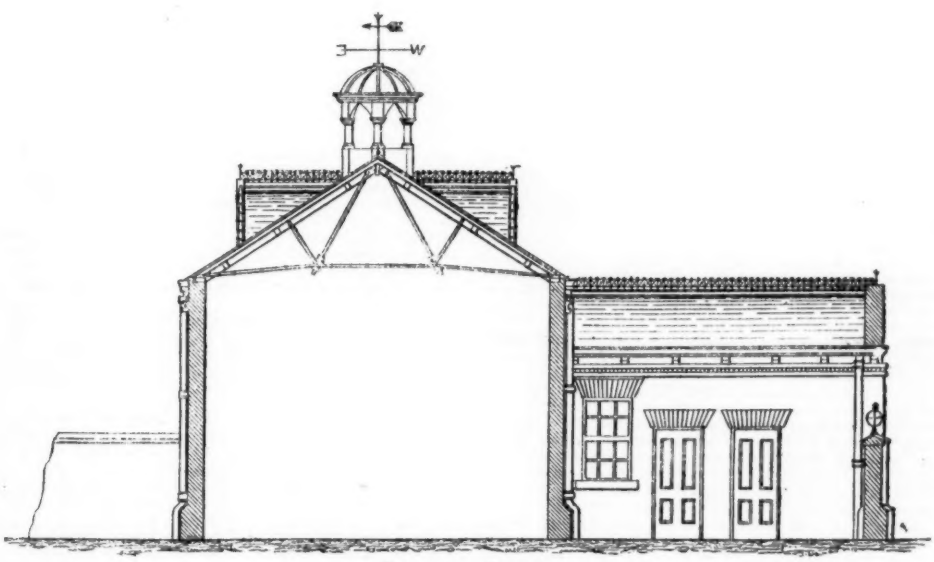
Mr. Dempster has erected other works, from the same designs, capable of manufacturing 100,000 cubic feet of gas per day.



Front Elevation.



Side Elevation.



Transverse Section.

Correspondence.

METER-FIXING WITHOUT NOTICE.

SIR,—Will you allow me to inform "A Country Manager" that there is no Act to enable him to proceed against the parties he names, for removing or fixing meters without notice, as his company is unincorporated. If his company were incorporated, clause 15 of the Gas-Works Clauses Act, 1871, would have given him power to proceed against them. What he should do now is to get his directors to pass a bye-law, putting a fine of £2 upon *consumers* for allowing such breaches. He can recover it by summons before a magistrate, or cutting off the gas until paid. He must prove damage, or breach of a bye-law.

Lower Sydenham, S.E. MAGNUS OHREN.

Parliamentary Intelligence.

HOUSE OF COMMONS COMMITTEE.

THURSDAY, MARCH 23.

(*Before Mr.* ORR-EWING, *Chairman; Col.* RUGGLES BRISE, *Lord* RENDLESHAM, *and Mr.* BROGDEN.)

STOCKTON AND MIDDLESBROUGH WATER BILLS.

(*Continued from page 577.*)

Mr. *H. W. F. Bolckow*, M.P., examined by Mr. VENABLES.

I am member of Parliament for the borough of Middlesbrough. I was senior partner of the firm of Bolckow, Vaughan, and Co. for many years. They are now a limited company, and I am the chairman. I may say I have been in Middlesbrough during its whole history. I should think the prosperity of the district would increase from year to year. I believe the present supply of water for domestic purposes is not what it ought to be. I know the place from which the corporation propose to get the water—the higher gathering-grounds—and approve of their scheme. I am perfectly aware that it must involve a certain expenditure of money, but I think it is absolutely necessary it should be done. It is not possible to know what the ultimate water requirements of the district will be. I think, with the enormous quantity which must be required, it is imperatively necessary that the control of the supply should be in the hands of the public authorities, who are responsible for the health of the inhabitants. They have the means of satisfying that responsibility if they have the control of the water. They would be able to get it in such a quantity, and of such a quality, as is really necessary for the benefit of the inhabitants.

By Sir JOHN DUCKWORTH: There is a large district which the water company do not supply, and they are quite unable to meet the wants of the increasing population.

The CHAIRMAN: I take it that, seeing a new quantity of water is required, the power should be—guarding vested interests—given to the authorities to supply it, and also to look after the quality of the water.

Witness: Yes, I think it is absolutely necessary.

Cross-examined by Mr. SUTTON: I believe the company have managed their business fairly well up to this time, as far as it has been in their power. They have supplied the whole of the district so far, but they cannot supply a different quality of water. As an ironmaster, I have not been much acquainted with the management of the works. I know there have been difficulties sometimes, but there has been a fair supply. I have no fault to find with the company at all, but I do not think the supply ought to be in the hands of a company in such a district as this.

Re-examined by Mr. VENABLES: I am one of the commissioners of the Tees Conservancy Board, who object very much indeed to the company getting more water out of the Tees. I think there is far too much taken out of it now.

Mr. *Edwin D. Latham*, examined by Mr. VENABLES.

I am civil engineer, and borough surveyor of Middlesbrough. I remember, in 1870, a report being made by the town-clerk to the corporation, on an intended visit of the Rivers Pollution Commissioners. I was instructed to make an exploration of the Tees, and examine the various villages and towns on its banks, to see how far it was contaminated by the discharge of sewage into it. I made the examination accordingly, and presented my report on Sept. 26, 1870. It stated that there were 10,190 persons above the point of the company's works discharging, indirectly or directly, into the Tees. The towns were Lower Coniscliffe, Higher Coniscliffe, Tarbury, Barnard Castle, Myddleton-in-Teesdale, and others. Barnard Castle has a water supply of its own, and has also a large number of water-closets supplied by that water. I happened to attend a meeting of ratepayers of Barnard Castle, at which Mr. Morgan, the Local Government Board Inspector in 1870, presided. My report as regards Barnard Castle was based upon the data which I obtained at that meeting. Mr. Morgan reported the result of the meeting, and said that he felt obliged to call attention to the serious pollution of the Tees, in consequence of the discharge into it of sewage from Barnard Castle, and that the matter demanded serious attention. In 1871 there were complaints at Middlesbrough of the quality of the water supplied. They were made chiefly by members of the Corporation to the Sanitary Committee. The faults attributed were that the water was discoloured, generally foul in appearance, and entirely unfit for human consumption. It was referred by the Sanitary Committee to the Medical Officer, to inquire into the matter, but the evil was not corrected. In consequence of no steps being taken, the Sanitary Committee appointed a Special Committee to make a personal inspection with the object of ascertaining the causes of the discoloration of the water. I assisted them, and was present when they made their report. They found that the water emitted a very disagreeable odour which I attributed to the intermixture of sewage matter from the towns and villages along the river. I have filtered the water through an ordinary charcoal filter, and it is not like the same water afterwards. I did not observe any disagreeable odour from it after filtering. I have often observed the water that has been used for town purposes in a very turbid state. I think it is certainly not a wholesome supply for domestic purposes—on the contrary, most unwholesome. I think the company should not have power to supply more of the same kind of water than they do at present. The filters of the company are mechanical, not charcoal. I have had considerable correspondence with the secretary with regard to the way in which they leave the streets, after taking them up for the purposes of laying down pipes and mains. They have about 40 miles of pipes in Middlesbrough, and they are in the habit of frequently opening the streets, so that it is very difficult to get back the original levels. If the Corporation had the control of the water, I think they would be able to manage these matters better. I am aware that the Corporation can take proceedings to compel the company to reimburse them for any outlay they may have to make in consequence of the company's negligence or default, but that power is practically inoperative. My knowledge of the company's scheme is general, not specific or detailed; therefore, I cannot speak accurately as to the engineering merits of it. As an officer of the corporation, I think parochial convenience and advantage would arise from the Corporation having possession of the works, in addition to what I have mentioned about the streets. It would be more advantageous to the inhabitants generally.

Cross-examined by Mr. SUTTON: I communicated with the company's agent when I made my inspection. I did not invite him to attend the examination. He gave me what information he could. In my report I did not divide the sewage discharged into the main stream, and that discharged into the tributaries; 364 water closets discharge into the sewer, and a great number of the privies are not substantially dry. Those that are near the river drop into it. I have not counted how many there are that do this. The principal item in the question of pollution is, no doubt, due to the water-closets. With regard to the sanitary appliances of Stockton, my report said the principal outfall into the Tees on the north side of the river was in a dilapidated condition, while on the other side the sewage fell into the river, and the health of the inhabitants was greatly injured. That was my opinion at the time I made my report of the condition of things there. The water I have spoken of as being discoloured and having a bad odour had not been filtered by me, but was supposed to have been filtered by the company. If the water is passed through a good charcoal filter, it will keep for 48 hours. After filtering it through charcoal, its colour is as good as one could wish to see it, and there is nothing then unpleasant in the smell of it. We get a large per centage of the sewage discharged from Stockton into our water. I understand that the corporation propose to gather water from the river Balder. There is a considerable amount of salmon fishing in that river. There is a provision in the general Act that if the company disturb the streets, and do not properly repair them, they are liable to a fine. We have not endeavoured to enforce that provision, for the reason that the company have, at least, 40 miles of mains and pipes in our streets, and to watch their operations would require as large a staff as they themselves employ. I do not think it worth while to have an inspector to look after the company breaking up the streets.

Re-examined by Mr. BROWNE: On one occasion, after the company had been breaking up the streets, we had to set to work to reconstruct the man-hole of one of the sewers. It would be more economical to have the work done by the servants of the corporation than to have one set of workmen to watch another set. Stockton and Middlesbrough are almost identical, so that I think they should be united for the purpose of a water supply.

Dr. *John A. Malcolmson*, examined by Mr. BROWNE.

I am medical officer of health for Middlesbrough. I have made an examination of the Tees for the corporations, and visited the towns and villages on its course. I got the populations from Mr. Latham, and counted the houses and made a calculation for myself. The total population on the banks of the Tees, calculating four to a house, was, last year, 10,980. Barnard Castle which most seriously contaminates the river, had a population, in 1871, of 5000. Below Barnard Castle the water was very much discoloured from the drainage, and I saw fœcal matter flowing down the river. At Gainsford a sewer flowed into the river, and that was eight miles below the company's pumping-station. At Middleton-in-Teesdale, when the river was low, I found a great mass of fœcal matter at the mouths of the sewers, and the next day, after a flood, I found it was all swept away. The churchyard is near the river, and any water flowing from it must go into the river. Many privies overhang at Barnard Castle and Middleton, and I saw, from the hush coming down the stream, that water pumped from the lead mines was there. I think the water from the Tees is, therefore, unfit for human consumption, and I do not think any amount of flowing down stream would make it fit. If there was any epidemic at Barnard Castle or Middleton, it would be dangerous to use the water which might convey the germs of disease. In 1874 the death-rate of Middlesbrough was exceedingly high; but it was much less in 1875. The corporation are endeavouring to carry out better drainage.

Cross-examined by Mr. LITTLER: It was a high death-rate for a country town. I call it a country town, as compared with London, and its death-rate is higher than London. A good many houses in Middlesbrough are built on slag and refuse. One part of the town is considerably higher than the other, and both drink the same water. I have not analyzed the water, and I do not know whether the borough analyst has done so. I am not aware that in the upper district the population is decreasing instead of increasing. Water purifies in a long distance in a river having a rough bottom; but it takes a very long distance. I take Dr. Frankland's view of that question; but I think nearly every chemist of eminence differs from him on that subject. Population is one test as to amount of contamination, unless they have adopted means of irrigation; for merely having cesspools which are cleared out will not prevent the contamination. Darlington has the same water as Middlesbrough; but I do not know what its death-rate in 1873 was as low as 20 per 1000. I do not know what it was.

Re-examined by Mr. BROWNE: I never taste the company's water myself, but the water-jug in my bedroom has to be cleaned out once a week from the incrustation upon it. If we got proper water and other matters, we should prevent much of the disease in Middlesbrough. Slag itself is not noxious, but it makes a bad foundation, and is not desirable.

Mr. LITTLER: If the damp gets to it hydrogen gas is evolved?

Witness: Yes; but the way is to concrete the floor, and then damp will not get to it.

By Mr. BROWNE: I read the report of the Rivers Pollution Commissioners, that there was no river long enough in the United Kingdom to effect the destruction of sewage by oxidation.

Mr. LITTLER: That is only Dr. Frankland's opinion.

Mr. *Edwards*, the borough surveyor of Stockton, gave a detailed account of an examination he made of the upper part of the Tees, where he found numerous drains emptying all sorts of filth into the river. At one place he saw dead pigs and entrails of animals in a ditch which emptied into the river; and on the banks were pigsties, stables, and a cemetery. About 12,000 persons actually drained into the river above the pumping-station of the company, so that the Tees was practically the sewer for all that district. He thought the scheme proposed by the bill, of impounding the flood waters, would be advantageous to the district, by giving a pure and adequate supply of water. The Stockton Corporation were charged in sections for their water, from 6d. to 1s. 6d. per 1000 gallons, instead of receiving the benefit of the large traders clause, and being charged in one sum for the whole.

Mr. *Scaith*, agent to the Duke of Cleveland, said that his grace owned a large portion of the property between Barnard Castle and Tees Cottage, which would be supplied with water under the corporations scheme. That would be to the advantage of those villages which were now dependent on wells, the majority of which were unfit for human use. The proposed gathering-ground was the best that could be obtained; while the present supply of water by the company was unfit for drinking, although it was good for manufacturing purposes.

Mr. *Dent*, agent to Mr. Bowes, of Streatham Castle, said that Mr. Bowes owned 34,000 acres on the proposed gathering-grounds. There was a very bad supply of water at Streatham, and in summer, when the springs were dry, they had to carry the water long distances. If the company obtained their bill in preference to that of the corporations, it would be injurious to the fishing.

Mr. *Milbank*, M.P. for the North Riding of Yorkshire, said he resided in Lune Dale, and the River Lune was a torrent in rainy weather. He had made a lake on his estate a mile in length, and from 25 to 40 feet in depth, which had held water for some time, and there was always a plentiful supply. By the scheme proposed by this bill, there would be an abundant supply of water, while it would not injure the Lune in any way, and the fishing would be improved.

Mr. *Allison*, the tenant of Glassholme Mill, at the head of the proposed reservoir, said he had only known the water fail three times in 45 years, while it was only peaty after a flood. The Lune was a sweet and clear stream.

Mr. *Robinson*, the tenant of the Ury Mill, said he had only known the water fail twice in 13 years. The peaty appearance was from Howe Beck, which was below the Lune.

Mr. *Hills*, of Yarm, said a committee was appointed there to consider the water supply, and they reported that it could be done for 6d. per 1000 gallons, while the company wanted to charge them 1s. per 1000 gallons, and they to find their own plant. They would prefer to get water from the corporations.

Mr. *Richardson*, J.P., chairman of the Stockton Local Board, said that resolutions were unanimously passed in favour of this bill, both by the board and the ratepayers.

Mr. *Thorne*, surveyor of the South Stockton Local Board, complained of the company taking pipes through that town to supply Middlesbrough, in consequence of which the streets were frequently broken up. They also refused to supply hydrants.

(To be continued.)

Miscellaneous News.

INDEPENDENT GASLIGHT AND COKE COMPANY.

The Half-Yearly General Meeting of the Shareholders in this Company was held at the Albion Tavern, Aldersgate Street, London, on Wednesday, the 19th inst.—JAMES BRICKWELL, Esq., in the chair.

The SECRETARY (Mr. James B. Conison) having read the notice convening the meeting, the following report and statements of account were presented:—

The directors have to report that the scheme of amalgamation agreed upon between this company, the Imperial Gas Company, and the Chartered Gas Company, has received the sanction of the Board of Trade, and was confirmed by an Order in Council, dated March 24, 1876. According to the terms of the City of London Gas Act, 1868, this confirmation has all the force of an Act of Parliament. As the scheme takes effect from the 1st of January last, the accounts of the Independent Company from that date merge in those of the United Company.

The directors recommend that a dividend be declared as follows, viz.:—On the £40 A shares at the rate of 10 per cent. per annum; on the £10 B shares, 5 per cent.; on the £20 C shares, 7½ per cent.; and on the £10 D shares, 10 per cent. per annum.

Dr. *Revenue Account, for the Half Year ending Dec.* 31, 1875. *Cr.*

Manufacture—				Sale of gas—		
Coals		£31,847	11 4	Common gas, at 3s. 6d. per 1000 feet	£44,891	10 11
Purification		779	17 6	Public lighting	3,125	19 10
Salaries, works		884	15 0	Rental of meters	1,363	6 4
Wages, carbonizing		5,465	15 8	Residual products—		
Repairs and maintenance of works and plant, materials, and labour	£5,066 0 8			Coke, less labour and cartage	13,879	2 4
Less old materials sold	110 4 6			Breeze	190	8 0
		4,955	16 2	Tar	4,670	3 7
Distribution—				Ammoniacal liquor	1,905	15 10
Salaries		703	0 0	Rents receivable	123	19 2
Repairs, maintenance, and renewal of mains and service-pipes		1,324	17 7			
Repairing, renewing, and re-fixing meters		831	1 8			
Public lamps—						
Lighting and repairing		646	1 0			
Rents, rates, and taxes—						
Rents		59	10 0			
Rates and taxes		1,132	9 8			
Management—						
Directors allowances		850	0 0			
Salaries		610	0 0			
Collectors commission		902	19 4			
Stationery and printing		102	13 1			
General charges		439	2 10			
Auditors		50	0 0			
Law and parliamentary charges		170	0 0			
Bad debts		300	16 6			
Total Expenditure		£52,121	7 4			
Balance carried to profit and loss account		18,028	18 8			
		£70,150	6 0		£70,150	6 0

Profit and Loss Account (Net Revenue), for the Half Year ending Dec. 31, 1875.

Amount carried to reserve-fund	£1,900	0 0		Balance of net profit from last account, June 30, 1875	£16,138	18 3
Balance of net profit to be carried to next account, subject to half year's dividend to Dec. 31, 1875	22,153	1 6		Less dividend paid for half year ended June 30, 1875	10,575	0 0
					£5,563	18 3
				Balance of revenue account	18,028	18 8
				Interest on moneys deposited	46	14 7
				Dividends on reserve	413	10 0
	£24,053	1 6			£24,053	1 6

Balance-Sheet to Dec. 31, 1875.

Capital—				Outlay on works, as per last balance-sheet	£219,190	17 7
3600 A shares, £40 each	£120,000	0 0		Expended this half year	849	8 9
3000 B ,, £10 ,,	30,000	0 0		Stock of meters	15,069	3 6
3000 C ,, £20 ,,	60,000	0 0		Stock of coals and goods	12,486	5 1
4500 D ,, £10 ,,	45,000	0 0		Rental and good debts	34,760	18 10
Reserve-fund	25,500	0 0		Cash at bankers—		
Profit and loss account	22,153	1 6		General account	7,028	9 9
Debts and liabilities	12,055	17 0		Investments for reserve—		
Unpaid dividends	176	5 0		Three per cents. reduced	25,500	0 0
	£314,885	3 6			£314,885	3 6

The CHAIRMAN: Gentlemen, the report is necessarily very brief, and, as a matter of form, I have to ask, before making any comment upon it, or answering any question that may be put to me, that you will allow me to move—"That the report and accounts be received, adopted, and entered on the minutes of the proceedings of this day."

A SHAREHOLDER seconded the motion.

The CHAIRMAN: Before I put the resolution to the meeting, I will make a few remarks, and they shall be as brief as possible, for really I have very little to say to the shareholders, except to congratulate them upon the success that has attended our exertions in reference to the amalgamation. With respect to that important proceeding, there is little to add to the information you have already seen in print, so far as the terms and conditions of the arrangement are concerned. As a matter of fact, I may state that the scheme by which this company and the Imperial Company have become amalgamated with the Chartered Company has been approved by the Government, and nearly a month ago received the Queen's sign manual in Privy Council. That being the case, the three companies now constitute one company under the title of The Gaslight and Coke Company. I am sure it must be a very great comfort to all of us to know that our maximum dividends are thus secured to us in perpetuity. I believe we are the only metropolitan company who are thus secured. By the new arrangement, we are placed in this fortunate position, that so far as we are able to discern, nothing can interfere with our dividends in the future, because the approval of the amalgamation by the Queen in Council is tantamount in every respect to the passing of a special Act of Parliament authorizing the scheme. I cannot help believing that we are in a much better condition now than we should have been, had we continued to carry on our operations independently as a gas company. We might have gone on successfully for a short period; but it is very doubtful whether we could have permanently maintained our high position, and, therefore, as I say, it is a matter of congratulation for all of us that the amalgamation has been effected. I am not aware that there is anything in the way of detail that it is necessary for me to go into; but I shall be happy to answer any inquiries which the proprietors may put to me, and I shall then ask them to sanction the proposition which I have already made.

A SHAREHOLDER: With regard to the income-tax; will it be paid for us in the future?

The CHAIRMAN: I am quite prepared to answer the question, for it occurred to me that most probably it would be put to me at this meeting. I have, then, to say that, unfortunately—or fortunately, whichever you like—you will have to pay it. It is a great blessing that we have an income-tax to pay, particularly when the amount in the pound is so small. Of course, the larger the actual sum deducted, the larger the resources of the shareholder from whom it is deducted. This is the first time it has happened; but the public auditor would not have passed our accounts if we had not done so, and it would have been an unpleasant and difficult task for us, if we had paid the tax, to get it back again from you. We have not taken this step hurriedly; it was fully discussed, not only at our own board, but also by the other companies.

A SHAREHOLDER: What is the arrangement in reference to our meetings for the future?

The CHAIRMAN: Under the amalgamation scheme, the meetings of the united company will be held half yearly, in February and August. This is the last meeting of the Independent proprietors.

A SHAREHOLDER: It seems to me that the one thing we have to congratulate ourselves upon to-day, as the result of the amalgamation, is that we have the income-tax deducted from our dividends.

The CHAIRMAN: Allow me to tell you that in any case that would have happened. The investigation of our accounts is so rigidly carried out, that, whether we had remained independent or not, we must deduct the income-tax.

A SHAREHOLDER: With regard to this congratulation of each other, is it not a fact that we have paid a very large amount to obtain the amalgamation? What was the value of our freehold property that was handed over, and what was the amount of the reserve-fund? We have given all that to the Chartered Company, to guarantee us our dividend. It is probably pretty secure, but if the price of coal goes up very much, their proprietors will not be content with a small dividend that we may have a full one.

The CHAIRMAN: If they earn anything they must pay us. We are guaranteed as far as it is possible to be done.

A SHAREHOLDER: And we have paid a high price for it.

Another SHAREHOLDER: Will our stock rank as debentures or as preference?

The CHAIRMAN: As preference shares.

The motion was put and carried.

On the motion of the CHAIRMAN, it was then resolved—"That dividends be now declared as follows:—On the £40 A shares, at the rate of 10 per cent. per annum; on the £10 B shares, at the rate of 5 per cent. per annum; on the £20 C shares, at the rate of 7½ per cent. per annum; and on the £10 D shares, at the rate of 10 per cent. per annum."

The CHAIRMAN: Gentlemen, that is the whole of the business; I only trust the arrangements we have entered into may give the same satisfaction to the proprietors as they do to the board, who have had the details to carry out.

The proceedings then terminated.

SHEFFIELD WATER-WORKS COMPANY.

The Ordinary Meeting of Shareholders was held on the 17th inst.—Mr. G. MARPLES in the chair.

The directors report was as follows—

After payment of all expenses of the company, interest on debentures, and the sum of £32,094 5s. for dividends on preference shares, there remains the balance of revenue account, £16,604 14s. 2d. Out of this there was paid on the 1st of November last £9000, being a dividend on the ordinary capital of £450,000, leaving £7604 14s. 2d.

The directors recommend that to this sum shall be added the amount of £1632 5s. 10d. from the surplus fund, thus making up £9237 (on the augmented capital of £461,850) to be applied to a dividend, payable on the 1st of May next, for the half year ending the 31st of December last, making with that paid on the 1st of November last, 4 per cent. for the year, free from income-tax, which tax on the two half year's dividends amounts to £151 19s. 6d.

In accordance with the terms endorsed on the certificates of the B preference shares, the holders of 948 shares elected to convert them into £12 10s. ordinary (B converted) shares, on the 30th of June last.

The preference dividend on the remaining 17,052 B preference shares was paid on the 31st of December last, at 5 per cent. per annum, on the same terms.

In pursuance of the resolutions of the extraordinary meeting of the 23rd of July last year, 20,000 preference shares of £7 each, entitled F shares, were issued.

These shares have been accepted by the ordinary shareholders, except 684.

The 684 shares not so accepted were sold by public auction together with the 1530 shares which the resolution of the special general meeting directed to be sold, and the premiums realized (£724 4s. 3d.) placed in the usual manner to the credit of the surplus fund.

The directors very much regret the death of Mr. Francis Colley, by which they feel the company has lost a most valuable director.

Mr. Charles Wardlow, of Glossop Road, was elected to fill the vacancy in the directorship, caused by the death of Mr. Colley.

The following is the report from Messrs. T. and C. Hawksley, the engineers-in-chief:—

To the Chairman and Directors of the Sheffield Water-Works Company.

30, *Great George Street, Westminster, April* 2, 1876.

Gentlemen,—We have the honour to report that we have made a personal inspection of the embankments and other works of the Redmires, Rivelin, and Boxley reservoirs, and have found them all in perfect repair and excellent condition. The Dale Dike reservoir was duly finished by the 14th of June last, and the Damflask reservoir, with the diverted roads and the 24-inch main-pipe to Sheffield, by the 31st of December last, these being the dates prescribed by the company's Act of Parliament, passed in the year 1873.

Now that these three systems of reservoirs have been completed, the company's capabilities have become adequate, at the present rate of supply, to the wants of a population of more than half a million persons.—We are, gentlemen, your most obedient servants,

T. AND C. HAWKSLEY.

The CHAIRMAN, in moving the adoption of the report, remarked that it might interest the shareholders to learn, with reference to the company's mortgage loans, the directors had obtained all the money they required at 4 per cent., and that in fact they had declined to receive sums to some extent, at that rate, as they had had offered to them more loans than they could find debentures for, for the time being. In this respect their policy was likely ultimately to prove successful. With regard to re-rating, he might observe that nine months only were included in 1875, the increase not commencing until March of that year, and 1876 would reap the benefit of the remaining three months.

Mr. ROBERTS seconded the motion.

Mr. HOBSON, referring to the accounts for the year, said the balance to revenue for dividend he found was made up by £17,433, being interest on money expended on works not productive of income and in course of construction, charged to capital, and £1632 odd brought out of the surplus fund, making together £19,065. During the last five years the directors had thought fit to charge capital with

£70,340, money and interest otherwise chargeable against revenue; and, at the rate they were going on, in another six years it would probably be £150,000. Thus one-third of the original capital of the company would be burdened with a mortgage debt to the extent of 1½ or 2 per cent. over what would otherwise have been the profit of the company. A few years ago the directors thought fit only to declare a dividend of 3 per cent. He thought that, looking at the general results and the great work they had in hand, perhaps the most unwise resolution the board ever passed was when they raised the dividend from 3 to 4 per cent. They might imagine that they were keeping up the value of the shares if they had to be purchased by any other party, but as their accounts were all known to the public, all the capital not represented as being expended on the works would be so much set against the value of them. They were now dividing 4 per cent. on open stock, but they were returning next to nothing on it, because £17,433 had to be taken out of the capital to make £18,237 available for dividend; therefore they might consider they were going on a policy of mortgaging their property for the sake of a present dividend of 4 per cent. He did not care to propose a resolution, because he was not a shareholder of open stock, and it did not affect him, but he thought it would be a much wiser policy if the directors were to go back at once to 3 per cent. If they did that he ventured to say that in six years they would honestly be earning 3 per cent. without mortgaging the future at all. He named six years because that was assuming they would not expend much more capital. They were now at a resting-point which would enable them quietly to decrease the sum chargeable to capital every year. If they returned to 3 per cent., that, with the annual increase of rental, might enable them rapidly to recover themselves, would give the concern solidity, and they would not be mortgaging the interest for their children or any future dividend which they might earn. If this course were pursued, the property would remain a most valuable one, and if the corporation or any other body sought to purchase it, the company would be able to stand their ground. If the water-works were bought by the borough, the shareholders would receive a proper and full remuneration for all they had done

Mr. PERCY SMITH disputed the correctness of Mr. Hobson's figures. He had stated that the dividend offered to open shareholders was not being earned, but was being paid out of capital. That was not the case as far as he understood the accounts. The dividend offered to the open shareholders was fairly and honestly earned. The position of the company was this—that £1,150,000 had been expended on finished and productive works, and these works not only paid preference and debenture holders of stock upon them, but earned the shareholders a clear profit of £16,000. This £16,000 was augmented by £2000 or £3000 a year through the gradual growth of the town. The interest on £420,000 expended on works, at the present time unproductive, had, however, to be paid. At one time there was a doubt in the minds of the directors, as to whether they were not compelled by law to pay interest on the £420,000, out of the profits earned by the productive and finished works. They thought that in so doing they would inflict a great injustice on the present ordinary shareholders, for the benefit of those preference shareholders who should elect, at a future day, to become ordinary shareholders at par. A special case was raised for the Court of Chancery, and it was decided that so long as the capital was unproductive, fresh capital could be raised every year to pay the interest on these works. The capital so raised had to be considered as part of the capital of the unfinished works. As to the question which must agitate all their minds—how long was this to go on?—that could only be answered after full deliberation amongst the directors. The course of the directors was plain; whilst on the one hand it would be wrong to withhold any water which might be necessary for the town, on the other hand it would be wrong, with the decision of the Court of Chancery, if they burdened the revenue, for the time being, with the interest of the works, before those works could become really productive.

Rev. C. G. SANDFORD said at the present time the capital account stood at £1,582,000, and the expenses of working the company amounted to £13,000 a year. He put it, therefore, to the judgment and the practical knowledge of the gentlemen present, whether it was expedient to attempt to borrow, from year to year, so large a sum as £17,000, especially when that sum might be diminished by the prudential considerations referred to by Mr. Hobson? The time was coming when the capital account of the company would be £1,826,000; there would also be an increase of the working expenses. Was it expedient, when there were such liabilities before them, and when there was a possibility of an adverse decision on the subject of the 25 per cent., to go on with an outlay which in his humble opinion it was extremely expedient to diminish? The Dale Dyke and Dam Flask reservoirs were unfinished, and there were still expenses before them. It had been observed that the surplus fund was now only £1700. Was it not consistent with law and also with wisdom and prudence to diminish the expenditure of the company from year to year, much in the way that Mr. Hobson suggested? If there was any contradiction between the words of Mr. Hobson and those of Mr. Percy Smith, it was simply in the way of putting the case. The capital account might go on increasing until it was £1,826,000, and the working expenses from £15,000 to £20,000 a year, and he would ask if it were desirable for them to put in jeopardy the interests of the original shareholders, by entering on an unwise outlay and borrowing large sums of money. They might diminish this expenditure, and, if that policy were carried out, it would contribute a good deal to the stability of the company in future time.

Mr. HYDES altogether disagreed with the position taken by Mr. Hobson and Mr. Sandford. So far as he could see the matter, there was a little bright speck on the other side of the question—there were always two sides to a question. If he understood the question aright, they were fairly in for a considerable increase this year over and above the earnings of last year, and he took it for granted that the outgoing this year would also be reduced, inasmuch as certain guaranteed shares which were receiving 5½ per cent. would be reduced to 5 per cent. A considerable number of the shareholders had also elected to become open shareholders. There would be a natural increase of income arising from the working of the concern, and increased consumption. Therefore he did not see that they had anything to be seriously alarmed about, in the matter of working expenses. If the company were earning more by taking on new customers, the expenses would be paid out of that, and it would leave something in the shape of profit besides. He believed it to be a correct policy of the directors to charge to the capital account the interest on unproductive capital. According to his mind, the company had been forced unreasonably and unnaturally into the expenditure of half a million of money that was not necessary to be expended for something like ten years to come. As the directors had been forced into this expenditure, it was only right that those who had compelled it should bear the burden of it.

Mr. WILSON asked when the land at Crookesmoor would be made productive. It was an important thing that that matter should be attended to.

The CHAIRMAN said the old dam at Crookes would be used as a service reservoir for the Loxley Valley scheme, and until the engineer-in-chief had decided on his plans, the directors could not do anything in the matter. He added that the directors were much obliged to the shareholders for so well ventilating this matter. It was a great gratification to find that the shareholders understood the matter so well as they did. It was time that many of them took different views; but still, with diversion of views they ultimately arrived at the truth. These accounts extended only to the 31st of December last. The Dam Flask reservoir was only completed as to the parliamentary requirements on that day. The suggestions which had been thrown out would be carefully considered by the directors in the course of the ensuing year.

The motion was then put and carried, and the dividend recommended in the report was declared. The directors were re-elected, and thanks were voted to them for their past services.

The CHAIRMAN, in acknowledging the vote, said he hoped the time would come when the shareholders would be rewarded for all their patience and all their confidence by receiving a fair return on the capital embarked on this important undertaking.

SHEFFIELD UNITED GAS COMPANY.

The Half-Yearly Meeting of Shareholders was held on Wednesday, the 19th inst.—Mr. F. T. MAPPIN in the chair.

The directors report and accounts were presented as follows:—

The profits for the half year ending Dec. 31, 1875, are £22,725 16s. 7d., and will leave, after paying the maximum dividend, a balance of £814 2s. 7d. to carry to the credit of the reserve-fund.

The figures will be—

Dividend on £135,000 class A stock, after the rate of £10 per cent. per annum	£6,750 0 0
Dividend on £209,053 10s. class B stock, after the rate of £10 per cent. per annum	10,452 13 6
Dividend on £99,700 class C stock, after the rate of 7½ per cent. per annum	3,738 15 0
Dividend on 12,937 new ordinary £10 shares (£2 per share paid up), being after the rate of 7½ per cent. per annum, or 1s. 6d. per share	970 5 6
	£21,911 14 0
Surplus to carry to reserve-fund	814 2 7
Total	£22,725 16 7

With the above added, the reserve fund will stand at £39,981 7s. 6d.

Your board have decided to make, from the 30th of June next, a reduction of 1d. per 1000 feet in the company's charges for gas supplied to all consumers. By this reduction the maximum charge will be only 3s. per 1000 cubic feet. Calculated on the present consumption, the benefit to the consumers by this reduction will (in round figures) be £3300 per annum; and so long as the maximum price remains unaltered, the C stock and the ordinary £10 shares will carry a dividend after the rate of £9 per cent. per annum, instead of £7 10s. per annum, which they now bear.

Your board feel assured that the consumers of gas will fully appreciate the reduction of the maximum price of gas to 3s. per 1000 cubic feet, especially when they remember that this company, during the recent coal famine, made no advance in its then maximum charge of 3s. 1d.

Your board having exhausted the borrowing powers already sanctioned (viz., £20,000, authorized at the meeting on Oct. 18, 1866, and £20,000 at the meeting on April 19, 1875,) a resolution will be submitted, authorizing the further exercise of such powers to the extent of £20,000.

The village of Oughtibridge is now being supplied with gas by this company, at the prices charged at Sheffield.

Dr. *Capital Account, for the Half Year ending Dec. 31, 1875.* *Cr.*

Class A stock, fully paid up	£135,000 0 0	Land, buildings, parliamentary, and other expenses, works, and machinery (including mains to June 30, 1855)	£407,200 11 0
Ditto B do. do.	209,053 10 0	Mains from June 30, 1855	66,432 10 4
Ditto C do. do.	99,700 0 0	Meters	28,089 1 1
12,937 new ordinary £10 shares (2nd issue), £2 per share paid up	25,874 0 0	Balance	7,305 7 7
Amount raised on mortgage	39,400 0 0		
	£509,027 10 0		£509,027 10 0

Dr. *Revenue Account, Dec. 31, 1875.* *Cr.*

Half year's gas, meter, and other rents, due this day	£65,047 8 1	Half year's expenditure in the production of gas	£63,557 6 8½
Amount arising from the sale of coke, tar, waste lime, ammonia water, gas-fittings, and work done	21,869 10 0½	Paid mortgagees & bankers for interest during the half year	633 14 10
		Balance	22,725 16 7
	£86,916 18 1½		£86,916 18 1½
		Dividends payable May 1, 1876	£21,911 14 0
		Balance to be carried to reserve-fund, May 1, 1876	814 2 7
Balance brought down	£22,725 16 7		£22,725 16 7

Maximum price of gas, 3s. 1d. per 1000 feet.

General Balance, Dec. 31, 1875.

Balance of revenue account	£22,725 16 7	Ledger balances, and accounts owing to the company	£55,184 1 11
Ledger balances, and accounts owing by the company	48,545 18 3	Stores in hand	19,371 14 6
Balance of capital account	7,305 7 7	Balance due from bankers	4,019 14 8
		Balance due from cashier	1 11 4
	£78,577 2 5		£78,577 2 5
Reserve-fund, invested June 30, 1875			£37,747 16 5
Amount transferred from revenue, Nov 1, 1875			605 7 1
			£38,353 3 6
Interest to Dec. 31, 1875			814 1 5
			£39,167 4 11

The CHAIRMAN, in moving the adoption of the report, said the satisfactory position of the company's affairs rendered it an agreeable duty for him to appear before them on that occasion. They were able to pay a dividend of 10 per cent. on the A and B shares, 7½ per cent. upon the C shares and ordinary £10 shares, and, besides that, they were able to carry £814 to the reserve-fund, thus raising that fund to £39,981. The balance was not so much as the directors expected they would have been able to place to that fund; but, after going through the details of the working of the company for the past half year, they found that the cause of it was somewhat explained in comparing the two half years, the one ending Dec., 1874, and the other ending Dec., 1875. Comparing the half year ending Dec. 31, 1874, with the half year ending Dec. 31, 1875, they found they had had to pay the following items more in the past half year—namely, stokers wages, £1055; lime for purifying, £315; salaries, £223; smiths and labourers, £1047; repairs of works, £855; repairs of retorts, £894; buildings and sheds, £384; removing, £217; besides other amounts varying from £50 to £150. They also received a less amount for coke by £1715. On the other hand, they paid less for coals by £2129, they received considerably more for gas; and their products—such as tar, ammoniacal liquor, and the working of the chemical department—produced very satisfactory results. The paragraph in the report, informing the shareholders that the directors had decided to reduce the price of gas on the 1st of July to 3s. per 1000 feet as its maximum price, they would all be satisfied with. That, he thought, would raise the dividend of the C stock and the ordinary £10 shares, from 7½ per cent. to 9 per cent. He must admit that their calculations were based very considerably upon the present price of coal, which they hoped might be a normal price for some years to come. If that were so, besides paying the increased dividend, he anticipated they would also be able to increase the reserve-fund; and, should a coal famine hereafter overtake them, which no doubt it might, they would, in a great measure, be prepared for it. The shareholders must not suppose that the business of the company was carried on without considerable anxiety and responsibility to those who had the management in hand. For some time past they had had considerable difficulty in arriving at the desired results; they had endeavoured to find out the cause, and he hoped they were

now in process of finding out what they had long been trying to do. But, if they were not successful, the shareholders might depend upon it that the directors would persevere until they had accomplished the object they had in view—namely, to satisfy themselves that the working of the Sheffield Gas Company was, as to results, equal to any in the kingdom. In reading the reports of the London gas companies, one thing struck him very forcibly, and he thought the shareholders would like to know something about it. The matter had reference to the amount of rates and taxes which the Sheffield Company had to pay. The expended capital of the Sheffield Gas Company was £509,000, and the amount of rates and taxes which the company paid for the last half year was £4623. The London Gaslight Company, with a capital of £840,000 expended, paid in rates for the last half year only £2794; and The Gaslight and Coke Company, with a capital of £3,972,000, paid only £8088. He could mention other companies which paid in the same ratio, or something less. One, with a capital very nearly such as they had, the Commercial—viz., £437,000—only spent on rates and taxes £1860. He had always supposed and believed that the London people were very highly taxed for their improvements, but what would Sheffield people say if they were rated in the same proportion as the London companies? This was a matter that they hoped would not be pressed more heavily upon them than was the case now. The shareholders were no doubt aware that there had been great excitement in the gas world, more especially in London, with reference to the Chartered, Imperial, and Independent Gas Companies amalgamating, for which they had just obtained an Order in Council. Some of the terms which they had secured were considered favourable by some portions of the community, but were looked on adversely by others. For his own part he thought these companies had been very fairly treated on the whole by Parliament, and that they had some advantages as well as disadvantages in the new bill. For instance, they were enabled to pay 10 per cent. so long as they did not charge more than 3s. 9d. per 1000 cubic feet of 16-candle gas, measured by Sugg's burner, which was half a candle less than the Sheffield standard; so that if they could sell the gas at 3s. 8d. they could then pay £10 5s. per cent. dividend, and for every penny that they reduced the price of gas they could increase their dividend by ¼ per cent., and for every penny that they increased the price above 3s. 9d. the dividend was reduced ¼ per cent. This, he thought, was not unfair either to the consumers or to the shareholders. There was another remark which struck him very forcibly, and it was made by the chairman of the London Gaslight and Coke Company at their recent meeting. He said that the money which had been expended on parliamentary contests would have reduced the price of gas throughout the whole of London by 6d. per 1000 cubic feet. If that were so, he must certainly say it was a great scandal, and a severe loss for ever had been inflicted on the consumers of gas in the Metropolis. He only hoped that provincial towns would escape so great a calamity.

Mr. WATERHOUSE seconded the motion, and said that, with trade so bad as it was all over the country, it must be a great satisfaction and comfort to the shareholders to be connected with a thoroughly sound company like theirs. In fact, they might call it a mutual congratulation company. They could congratulate the directors, congratulate themselves, and congratulate the public. They could congratulate the shareholders upon the continued good management which had characterized the company for many years. They could congratulate themselves that they had their money invested in such a profitable, solvent, and thoroughly sound property, that the operations of sharebrokers and stockjobbers could not interfere with it. They could also congratulate the public, because in the matter of gas they had the maximum amount of advantage at the minimum cost. Some of the stockbrokers tried to send prices down in the market, but gas was an inflammable material, and they might burn their fingers if they meddled with this concern.

The motion was put and carried, and the dividends recommended in the report were declared.

A resolution was also passed, empowering the directors to borrow £20,000, under the provisions of the Sheffield Gas Act, 1866.

The CHAIRMAN said that was the whole of the business before the meeting; but he could not allow the present opportunity to pass without thanking Mr. Roberts and the officers of the company, but especially Mr. Roberts, for his great assiduity, and the efforts he continually made, in furthering the prosperity of the company. He had many opportunities of seeing the judgment and discretion of Mr. Roberts, and the great ability he displayed. He was sure the shareholders were very much indebted to him, and the directors fully appreciated the services that he rendered to the company. He would move that the thanks of the shareholders be given to the officers of the company.

A SHAREHOLDER seconded the motion, and said he could bear testimony to the truth of a great deal of what the chairman had said in reference to Mr. Roberts.

The motion was carried unanimously.

Mr. ROBERTS, in acknowledging the compliment, said it was exceedingly gratifying to have such an expression of confidence from the directors and the shareholders. It had been his endeavour to do the best he could for the interests of the company, and he was amply rewarded by knowing that he had given satisfaction. He assured them that he would do in the future as he had done in the past.

A vote of thanks to the chairman concluded the proceedings.

THE SUPPLY OF GAS TO THE METROPOLIS.

By Mr. HARRY CHUBB.

At the Ordinary Meeting of the Statistical Society on Tuesday, the 18th inst.—Mr. J. HEYWOOD, the president, in the chair,

A paper was read by Mr. HARRY CHUBB, late secretary of the Imperial Gas Company, and now a director of The Gaslight and Coke Company, on "The Supply of Gas to the Metropolis," of which we give a very full summary.

INTRODUCTION.

The writer commenced by observing that the use of coal gas as a means of lighting has become so general, and the quantity required, for such an enormous city as London, is now so large that some statistics in connexion with this important manufacture can scarcely fail to be of interest. The proper supply of gas having, indeed, become almost a necessity of civilized life, it may, perhaps, be assumed that interest will also be felt in the history of its introduction into London, and the constitution and obligations of the companies to whom the supply had been entrusted. It may further be presumed that no narrative can fail to be without interest which disclosed from experience the policy which the Legislature seems inclined to adopt towards undertakings founded on private enterprise. The paper, therefore, relates, shortly the dealings of Parliament and the various local authorities of the Metropolis from time to time with the several metropolitan gas companies.

The paper having been written before the recent amalgamation on the north side of the Metropolis was effected, the writer deals with the state of things then existing, when he next remarks that London is at the present time supplied by eight companies, who have separate districts assigned to them. There were originally thirteen companies, but five of them have, within the last few years, amalgamated with others. These eight companies have seventeen manufactories, the sites of which have been selected chiefly for the facilities they afford of obtaining coals by water carriage. The share and loan capital of the united companies amount to rather more than 11 millions sterling, and the maximum rate of dividend allowed to be paid on the total share capital averages 8·7 per cent. There are, in the aggregate, upwards of a million and a half tons of coal used every year in the manufacture of gas in the Metropolis, and the quantity of gas consumed amounted in the past year to about 13 millions of thousands of cubic feet. There are at present 54,119 lamps in the public streets in the Metropolis lighted by means of gas; and the mains of all the companies, of various sizes, from 4 feet to 3 inches in diameter, reach the enormous length of upwards of 2000 miles.

This immense trade has risen up within the last 60 years. Coal gas had been used in the provinces on some special occasions, for the purposes of illumination, for a few years previously, and notably by Mr. James Watt, at his celebrated Soho Engine-Works, near Birmingham; but it was not until the year 1807 that any attempt was made to show that such a material could be applied with advantage for the purposes of lighting in the Metropolis. In that year a small apparatus was set up in Pall Mall, and from it a few of the public lamps on one side of that street were supplied with gas in order to prove its practicability and its superiority over the system of lighting by the oil lamps then in use; but notwithstanding the undoubted success of that experiment, the scheme of thus lighting even the public thoroughfares was utterly condemned, and the use of gas in dwellings was denounced as unsafe, injurious, and impracticable.

Men of science joined in this opposition, and in ridiculing the idea as visionary. Even Sir Humphrey Davy, Sir Joseph Banks, and other celebrated men of the age, lent the powerful weight of their opinions and influence to check the proceeding, and so great was the prejudice against the introduction of the new system into London, that it seemed at one time to present an insurmountable obstacle to its further progress.

The inventors, or rather those who appropriated the invention and adapted it to practical use, were, however, so fully persuaded of the great benefit and the improvement which their system of lighting would effect, that they happily maintained their views, and ultimately, at great cost, and by dint of indomitable perseverance, worthy of all praise, prevailed with a sufficiently large section of the public to enable them to extend their operations.

HISTORY OF THE LONDON GAS COMPANIES.

In 1810, after two years of severe parliamentary struggle against powerful opposition, an Act was obtained, authorizing His Majesty to grant a charter within three years to a company, for the purpose of lighting a small portion of the Metropolis with inflammable gas, and under the powers of that Act the existing Chartered Gaslight and Coke Company, the earliest of all the metropolitan gas companies, were established. That company lost no time in erecting a manufactory of very limited dimensions in Peter Street, Westminster, then a wretchedly swampy district, frequently overflowed by the Thames, and on Dec. 31, 1813, they commenced operations by lighting the lamps on Westminster Bridge. This became so great an attraction, that the bridge is said to have been quite a fashionable promenade whilst the novelty lasted.

The authorities of the small parish of St. Margaret's, Westminster, next applied to have their streets thus lighted, and on April 1, 1814, the old oil-lamps in that parish gave place to the more brilliant light produced by coal gas.

Notwithstanding the evident improvement effected by the new mode of lighting the streets, the prejudice against its admission into shops and dwellings continued; so much so that the company, in order to obtain a trial, had, in the first instance, to furnish all the needful fittings, and supply the gas, free of expense. For nearly two years there was little or no increase in the consumption; and, in addition to the public prejudice, the difficulties the company had to contend with were many and serious, both in the manufacture and the distribution of their gas. Their apparatus was necessarily most imperfect, their acquaintance with the science of gas purification was very limited, and, the mode of constructing wrought-iron pipes by machinery being then unknown, the greatest difficulty was experienced in providing means for conveying gas from the mains in the streets to the houses to be supplied; for some time, indeed, old musket-barrels, attached to each other by screwing the muzzle of one into the breech of the other, were used for this purpose, and for many years afterwards, when machine-made wrought-iron pipes were introduced, they were called gun-barrel pipes from this circumstance. The cost of all fittings and material of every kind was also, at that time, so enormously high that the hindrances and embarrassments of the period must have been well-nigh overwhelming. They were, however, overcome; and when the Chartered Company had surmounted the principal difficulties, and opposition to the use of gas had somewhat abated, other companies were formed, who soon began to erect works in different parts of the Metropolis.

The next undertaking, in succession to the Chartered, was the City of London Gas Company, which were incorporated in 1817, for the purpose, as the name implies, of supplying the City of London. Then came the Imperial Company in 1821, seeking to serve the whole of the north side of London, north of Oxford Street and Holborn, and outside the City.

Afterwards the following ten companies were established, viz.:—

The Ratcliff, incorporated in	1823
The Phœnix "	1824
The Independent "	1829
The Equitable "	1831
The South Metropolitan, incorporated in	1842
The London, incorporated in	1844
The Commercial "	1847
The Great Central "	1848
The Western, not incorporated, but commenced operations in	1850
The Surrey Consumers, incorporated in	1854

In all thirteen companies.

In the first instance the companies had no exclusive privileges conferred upon them as to the monopoly of the supply in any district; they were also unrestricted as to the price they might charge, as well as the rate of dividend they might pay their shareholders on the capital invested.

Appended to the paper was the following table:—

Prices Charged by the several Companies for Gas at their Commencement.

Name of Company.	Date of Establishment.	Date of Incorporation.	Prices Charged for Gas, per 1000 Feet, at the Commencement.
Chartered	—	1810	In 1823, when meters were first used, 15s.
City of London	—	1817	1821, 15s.
Imperial	—	1821	1826, 15s.
Ratcliff	—	1823	1829, 12s. 6d.
Phœnix	—	1824	1824, 15s.
Independent	1826	1829	1829, 12s.
Equitable	—	1831	1831, 12s.
South Metropolitan	1834	1842	1834, 11s.
London	1833	1844	1834, 9s.
Commercial	—	1847	1850, 5s.
Great Central	—	1848	1848, 4s.
Western	1850	—	1850, 8s., cannel gas.
Surrey Consumers	—	1854	— —

Note.—Gas was originally supplied at per light. There were but few meters in use between 1821 and 1825; they did not come into general use till about 1830.

The author proceeds to observe that not only was the question of price and dividend unrestricted, but the quality of the gas to be supplied was also left to

the option of the companies, who were in no way bound to furnish a supply unless it suited them to do so.

The Policy of Competition.

As to the exclusive right to the supply in any particular district, Mr. Chubb remarks that Parliament seem to have taken pains, at a very early period, to define the mode in which gas should be introduced into London, inasmuch as they issued a commission, in 1822, to inquire into this subject. This commission was presided over by the celebrated Sir William Congreve, who advocated strongly, and the commission adopted his views in this respect, that only one company should be allowed in any district of the Metropolis. The wisdom of this advice has been amply proved by subsequent experience; but, at the time, the recommendation of the committee was not adopted, as, although the companies were incorporated for the supply of certain defined districts, the exclusive supply of that area was not conferred upon them, and very soon—as soon, indeed, as it was proved that the speculation was unattended with risk, and that gas could be made and supplied at a profit—Parliament encouraged competitive undertakings, by giving their sanction and approval to new companies.

The author supplies a table showing the rates of dividend paid by the several metropolitan gas companies in the earlier years of their establishment, from which it appears that from 1812 to 1817 the Chartered Company, who were incorporated in 1810, paid no dividends. In 1817 they paid 6 per cent.; and in the five following years 8 per cent.; in 1823, 7½ per cent.; in 1824, 7 per cent.; in 1825, 6½ per cent.; and from that time down to 1840, 6 per cent. In the case of the Imperial Company, established in 1821, no dividend was paid at all until 1824, when they paid 2 per cent.; in 1825, 4 per cent.; in 1826, 5 per cent.; in 1827, 3¼ per cent.; in 1828, *nil;* from 1829 to 1839, 5 per cent.; and in 1840, 5½ per cent. Although, as he remarks, the old companies had up to that time paid very indifferent dividends, speculative investors were found willing to embark their capital in new undertakings empowered to supply districts already served, under the authority of Parliament, by the old companies.

In pursuance of this policy, the Independent Company were established, in 1829, to compete with the Imperial; the Equitable Company, in 1831, to compete with the Chartered; the London Company, in 1844, to compete with the Imperial, the Equitable, and the Chartered; the Great Central, in 1848, to compete with the two companies supplying the City; and the Surrey Consumers, in 1854, to compete with several companies on the south side of the Thames. The Western Company were also admitted by the several vestries, without parliamentary sanction, in 1850, to compete with the Chartered, the London, and the Imperial. These several competitive companies were generally formed and promoted by bodies of consumers working in concert with the local authorities, through whom contracts were obtained at low prices for the supply of gas to the public lamps. In this manner a footing was gained in a district, and competition secured. Under this system, which prevailed from 1830 to 1857, many of the public thoroughfares were occupied by the mains of as many as four different companies, each of whom required to open the roadways frequently to make connexions with, or to repair, their respective mains. It was, of course, impossible to distinguish one set of mains from another, consequently one company would frequently obtain a supply for their customer from another company's main. It was also impossible to say, when there was any escape of gas, from which company's main the leakeage might be, hence all the companies opened the ground, and the surface of the road was scarcely ever at rest. The companies incurred great loss from the outlay of capital for four sets of mains where one would have sufficed, as well as loss of gas by leakage, owing to the difficulty of keeping the mains in proper repair, and the public suffered great inconvenience from the confusion naturally resulting from such a system.

The result of this competition also, so far from cheapening the supply of gas to the public, only led to increased expenditure, and eventually to an arrangement between the competitive companies to charge a uniform price, and to make the best dividends they could on their capitals, a considerable amount of which had been expended uselessly in laying several sets of mains in competition with each other. This led to the adoption by the companies themselves generally, in 1857, of the system recommended by Sir William Congreve—viz., of dividing London into districts, each to be supplied by one company, whereby they improved their own position, without in the slightest degree prejudicing the interests of the public. The argument, that by means of competition the public would get cheaper gas, is utterly fallacious, inasmuch as, according to a very true apothegm of the late Mr. Robert Stephenson, "when combination between two or three public companies is possible (their number being necessarily limited), competition is impossible;" for, of course, they will not long continue to ruin each other for the benefit of the public, nor are there any means of compelling them to do so. Moreover, experience has shown that, since the abandonment of competition between the London gas companies, the price of their gas has been materially reduced, to the great advantage of the consumer, as might reasonably have been expected from the greater economy in the distribution of gas resulting from it.

Metropolis Gas Act, 1860.

The writer says the public have a horror of the name of "monopoly," and, therefore, as soon as the companies had resolved to divide London into districts between them, the consumers raised a great outcry, on the plea that, hereafter, the price of gas might be increased, and that, being at the mercy of only one company, the public would have no means of redress. This agitation led to long inquiries before parliamentary committees in 1858, 1859, and 1860, and, eventually, to the passing of the Metropolis Gas Act of 1860, which distinctly recognized the wisdom of the course pursued by the companies, and the expediency of allowing only one company in each district of the Metropolis; but, at the same time, it placed all the companies under most severe obligations and restrictions for the benefit of the public, both as to price, illuminating power, purity of their gas, the maximum rate of their dividend, and other matters, as the condition of their enjoyment of a monopoly.

The writer proceeded to enumerate the obligations imposed upon the companies by the Act of 1860, and the advantages which the public derived therefrom. The former were—1. That the companies were bound under penalties to furnish an ample supply at all times to every one in the district requiring it, and practically to extend their mains whenever required in that district, either for the public or private supply. 2. They were restricted to the maximum price of 4s. 6d. per 1000 cubic feet for 12-candle gas, except any extraordinary emergency should arise, when the Secretary of State for the Home Department had power to authorize an increase of price to the extent of not exceeding 5s. 6d. per 1000. 3. They were subject to heavy penalties if their gas was at any time below the standards of illuminating power and purity fixed by the Act. 4. They were obliged to supply meters at fixed rentals. 5. They were to publish their accounts annually, with such details as the Home Secretary might require, so as to show distinctly the amount of profit they were making. 6. Their dividends were limited absolutely to 10 per cent. per annum. All surplus profits beyond the amount sufficient to pay dividends at that rate, and to form a reserve-fund of a limited amount wherewith to maintain that rate of dividend, were to be applied in the reduction of the price for gas. 7. Power was given to quarter sessions, at the instance of any two consumers, to order an investigation of any company's accounts at any time, and arbitrarily to reduce the price to be charged for gas if on such investigation it should appear that the companies profits would admit of such reduction.

Such, the author remarks, were the advantages conferred on the public by the Metropolis Gas Act of 1860, and such were the onerous obligations imposed on the companies as the price of the recognition by Parliament of the system of "districting" adopted by them.

Renewed Agitation against the Companies.

The steady increase in the demand for gas, and the obligation put on the companies to supply every one who might require it, compelled the companies to expend additional capital year by year in enlarging their manufactories and extending their mains, in order that they might be able to fulfil their obligations, and ere long, as the power granted to them of raising the necessary capital became exhausted, they had to apply to Parliament for additional powers. At such times they were strenuously opposed by the local authorities; that is, either the Corporation of London within the City, or the Metropolitan Board of Works outside the City, who pleaded that advantage should be taken of the opportunity afforded by the exigency of any company to extract some further conditions from them in favour of the public.

This agitation reached a climax in 1866, when the local authorities pleaded that the Act of 1860 was more favourable towards the companies than was intended, and Parliament appointed a special committee to inquire into the question. This inquiry was followed by another committee in 1867, presided over by the present Lord Cardwell, who, yielding to the views of the Opposition, recommended Parliament to empower the local authorities to erect works, and supply gas in competition with the companies out of the public revenue, unless the companies would consent to accept his terms, which terms altered entirely the title and conditions upon the faith of which the shareholders had invested their money, and which title Lord Cardwell admitted, in the report his committee made to the House, that Parliament could not justly deprive the companies of without their consent.

The terms referred to in the report were, that an arbitrary initial price should be fixed for gas—viz., 3s. 9d. per 1000 cubic feet—with an illuminating power of 16 candles, and that if any company could pay 10 per cent. at that price in any year, they might do so; if they could not, they might, in the following year, call upon Government to appoint three commissioners to make inquiry. These commissioners were authorized to raise the price for one year, if they should think it right, so as to allow the company in that year to pay a dividend as near as may be, but not exceeding, 10 per cent. In no year was the profit earned to be supplemented by the excess of profits in any other year, and the system of the reserve-fund was altogether abolished. In like manner the local authorities were empowered to call in the aid of the commissioners for an inquiry, with a view to a reduction of price below 3s. 9d. per 1000, in case they should consider that a less price than 3s. 9d. ought to pay 10 per cent. These powers were termed the "revision clauses."

The Gas Acts of 1868-9.

In the next year the Corporation promoted a bill, following out Lord Cardwell's suggestion, for power to erect works and supply gas in the City in competition with the companies, at the expense of the public rates; and in 1868 the same committee, again under the presidency of Lord Cardwell, having repeated their threat that they would pass the Corporation Bill unless the terms referred to were accepted, the three companies supplying the City, who would most certainly have been utterly ruined by such unequal competition with the Corporation, were most reluctantly compelled to accept Lord Cardwell's conditions, which were accordingly incorporated into the City of London Gas Act, 1868, and the three companies were amalgamated into one. The other companies, who were serving districts outside the City, and were not affected by the threat of competition by the local authorities, absolutely refused Lord Cardwell's terms; and Parliament happily modified those conditions, in some important respects, in the case of the Imperial Company in the next session (1869), when that company repeated their application for the means wherewith to comply with the obligations imposed upon them.

In the years 1872, 1873, and part of 1874, the coal famine occurred, when the cost of the material from which gas is produced rose from an average of 14s. to 32s. per ton; consequently, the majority of the companies who remained under the Act of 1860, raised their prices of themselves, as they had the power to do, to enable them to meet the emergency; but the two largest companies—viz., the Chartered and the Imperial, who had no power to raise their prices of themselves, were obliged to submit their circumstances to the arbitration of commissioners, under the revision clauses of the Acts of 1868 and 1869. The results of those applications were wholly in favour of the companies, although the local authorities offered the most strenuous opposition to any increase of price above 3s. 9d. The commissioners gave both companies authority to charge such an advance as they estimated would be sufficient to yield the maximum rate of dividend during the years of pressure, and no subsequent appeal having been necessary after 1874, the initial price of 3s. 9d. was resumed on the 1st of January, 1875.

The Metropolitan Board and Corporation Bills, 1875.

This result of the operation of the revision clauses, which originated with and were framed by the local authorities themselves, seems to have exasperated those bodies excessively. They insisted that the powers of revision were never intended to be the means of raising the price for gas, but only of reducing it; finding, however, that no one agreed with them in this view of the question, they resolved to endeavour to get the revision clauses repealed, and to devise some new scheme for the subjugation of the gas companies. Accordingly they lost no time in making another appeal to Parliament, and in the session of 1874-75 the Corporation of London and the Metropolitan Board of Works unitedly promoted three bills, the character of which it is difficult to name respectfully, viz.:—No. 1. A bill to enable those bodies to establish new gas manufactories, and to lay down duplicate mains all over London, involving a probable outlay of 10 millions sterling, so that they might manufacture and sell gas in competition with the existing companies over whom those bodies had the control; whilst they themselves were not to be subject to any control, or to any of the restrictions or obligations imposed on the companies. No. 2. A bill to enable those bodies to purchase the undertakings of the gas companies compulsorily, at prices fixed by the purchasers themselves. No. 3. A bill entitled the "Metropolis Gas Regulations Bill." The real object of this last bill was to repeal the revision clauses of the Acts of 1868-69 before referred to, and in their place to enact that the price of 3s. 9d. per 1000 cubic feet should be the maximum price which any of the companies might hereafter charge, without suffering the penalty of a reduction in the prescribed rate of their dividends, which it was proposed should be decreased by a quarter per cent. (be the maximum or prescribed rate 10, 7, or 5 per cent.) for every penny the companies might charge above 3s. 9d. per 1000. Or, in other words, the companies being compelled to supply gas, were to be made to suffer in their dividends for any rise in the cost of coal or in the rate of wages, over which they could exercise no possible control—there was no provision in the bill for any increase of dividend, in case the price of gas was reduced. No. 1 bill was to be used as a *brutum fulmen* to compel the companies to surrender, and to accept the unreasonable conditions of bill No. 3; and No. 2 (the Purchase Bill) was to be kept in reserve, so as to enable the public bodies to pick up the undertakings of the companies after they had been so depreciated, by the operations of the Regulations Bill (No. 3), as to be a burden and a loss to the shareholders.

Such, remarks Mr. Chubb, were the designs of our renowned Corporation of the City of London, aided by their brethren the Metropolitan Board of Works, but those designs were happily too transparent to be successful. The present Government gave the promoters no encouragement, so that they were fain to

withdraw bills Nos. 1 and 2, and as to bill No. 3, the Chancellor of the Exchequer (Sir Stafford Northcote) said openly in the House on the second reading of that bill, that the clause which proposed to reduce the dividends, if the price for gas exceeded 3s. 9d., "amounted to a breach of faith, and was an unfair clause to be adopted. If that clause were to be considered an essential principle of the bill, the House, he thought, would pause before it gave its consent." Again, "It would be the duty of the Government to watch the bill carefully when it came back from committee, and if that clause came back in its present shape, it would be impossible to allow the bill to proceed any further."

With this warning on the part of the Government, the bill was sent to a select committee, of whom Mr. W. E. Forster was the chairman. Whilst the bill was under consideration, the Board of Trade adopted the very unusual course of addressing a letter to the Committee, suggesting that, in the opinion of the Board, the justice of the case would be met by allowing the dividends of the companies to rise, as well as fall, above or below the prescribed rates, inversely with any increase or decrease in the price of gas, 3s. 9d. per 1000 being adopted as the initial price for gas equal to 16 candles of illuminating power, and this suggestion the committee adopted, by resolving to recommend the repeal of the revision clauses of 1868 and 1869, on the faith of which the companies had raised and invested more than two millions of capital, and to substitute in their stead the entirely novel legislation of making the companies suffer or gain in their dividends by the rise or fall in their price for gas, notwithstanding that the companies have no power whatever to control the price of the raw material from which such gas is to be made, and which they are compelled to supply, whatever loss they may thereby incur. When this decision was announced, the companies, with one exception, withdrew from the committee, with a view to an appeal to the House itself, but owing to the lateness in the session when committee reported the bill, it did not reach the stage of being read a third time, and so dropped.

The Regulations Bill, 1876.

But the bill, as passed by the committee in the form here described, has been again brought in by the promoters in the present session; but the shareholders of the metropolitan gas companies are still disinclined to believe that the Legislature will inflict upon them so grievous an injury, or exhibit so manifest a departure from good faith or sound policy towards private enterprise, as to force the bill in question upon them. It is true that, at the present price of coal, the companies can pay their maximum rates of dividend at the price of 3s. 9d. per 1000 feet for 16-candle gas; and it may even be admitted that a reduction of price, which will enable the companies under the scheme to pay higher dividends than heretofore, is probable under existing circumstances; but who can ensure that the present cost of coal will continue for another year? Or who will be bold enough to say that if, after the companies have once surrendered their parliamentary title, and having accepted the sliding scale scheme, are able, by a reduction in the price for gas, to pay more than their existing maximum dividend, their adversaries will not immediately cry out that "the initial figure of 3s. 9d. is too high;" and, repeating their old tactics, plead that it is more favourable than was intended, and agitate for its reduction? There is, therefore, no finality in the proposed settlement, for experience has proved that when the companies seem to be prosperous, a clamour is sure to arise, and, according to the views of our local authorities, that state of prosperity would afford a sufficient reason for abridging the powers by which it had been occasioned. The shareholders of the several companies by no means covet the supposed boon which is held out to them—of liberty to pay higher dividends than those already prescribed. The new scheme, they say, would obviously change entirely the character of their investment from a guaranteed stock—which it really is at present—into a speculative enterprise, wholly dependent upon the rise and fall in the cost of coal. They, therefore, decline the offer, which they consider to be wrong in principle.

Popular Prejudices against Gas Companies.

In seeking to find some justification for the attitude which the local authorities assume towards the companies, our author admits that the companies are certainly by no means popular bodies. One is accustomed to hear them spoken of everywhere, and by almost every one, by the most opprobrious terms. They are accused among other things of being overbearing towards their customers—exacting in their charges—supplying abominably bad gas—of being able in some way, how, no one else knows, to make meters register a much larger quantity of gas than can possibly have been consumed—of lighting the public streets most indifferently—of always disturbing the roadways in the streets unnecessarily, and never properly repairing them after disturbance—and of making fabulous profits out of the much injured consumer, which profits it is asserted are either distributed among the shareholders, in some occult way, far in excess of their authorized dividends, or are spent recklessly in paying princely salaries to the directors and officials.

This selection from the catalogue of crimes attributed to the metropolitan gas companies are matters of almost general faith—but a few facts and words of explanation ought to satisfy any reasonable person that there is no foundation whatever for any one of these accusations. The alleged overbearing conduct is probably due in some measure to the necessity which exists for the companies to ask their consumers to pay their accounts with some degree of punctuality. But the London companies, in order to spare their customers as much trouble as possible, collect their accounts, not monthly, as they do in many of the towns in the provinces, in all the continental cities, as well as in all the cities in the United States, but quarterly. No part of the duty connected with the management of a gas company is so trying as this collection of debts. In London the accounts of those residing in private dwellings, even in the wealthier districts, average only £11 a year, or £1 15s. in autumn quarter, and £3 15s. in winter, and as the companies have to pay for all the coals they consume, as well as the wages of the large number of men they employ, week by week, it is essential to economy and good management that the moneys due to the companies should be collected as promptly as circumstances will admit. Experience has proved also that long credit results in bad debts; and, as a proof of the forbearance of the London companies, it may be stated that their losses from bad debts amount to about £14,000 a year, or nearly one-half per cent. on the total amount of their receipts arising from the sale of gas. In the other cities referred to where the collection is made every month, and where no such forbearance is shown as in London, a bad debt is unknown.

Price of Gas in London as compared with other Places.

As to the alleged high price charged in London, the inhabitant who makes such a complaint can be scarcely aware that in no city in the world, outside of England, is the supply of gas so good as to quality, or so cheap as to price. In London, the normal price is at the rate of 3s. 9d. per 1000 cubic feet for gas equal to 16 sperm candles in illuminating power. In the undermentioned cities, where the quality is much inferior, the price is as follows, viz.:—

Paris	6s.	7½d.	per 1000
Berlin	4	3½	,,
Amsterdam	5	0	,,
Vienna	5	8½	,,
New York	10	0	,,
The other cities in the United States	12	0	,,

In some of the northern cities of England and Scotland, which are situated close to the coal-fields, and where the cost of labour, land, and material is much less than in London, those cities may have gas cheaper and of a higher illuminating power than London; but in order to institute a fair comparison between them, the circumstances under which the same is supplied in each should be duly weighed and considered.

Illuminating Power of London Gas.

The standard of illuminating power for the gas supplied in London has been fixed at 16 candles, for the reason that no higher illuminating power can be produced without the use of a very large quantity of rich "cannel" coal. Even 16-candle quality requires the admixture of nearly 10 per cent. of that coal with about 90 per cent. of certain descriptions of Durham coal. Good cannel is becoming very scarce, and therefore costly, and the coke which is produced from it is of very inferior quality. The price of cannel has gone up nearly 50 per cent. within the last few years; the owners of it are very few in number; and it is obvious that if the illuminating power in London were raised so as to compel the companies to employ that description of coal exclusively, or even in much larger quantities than at present, they would be placed at the mercy of the cannel coal owners, and it would be utterly impossible to supply gas in London at anything like the present prices.

Consumption of Cannel Coal.

The writer, in an earlier part of his paper, stated that the quantity of coal now consumed in London amounts to 1,500,000 tons per annum, and a reference to a table here given shows that the total yield of cannel of all kinds amounts to no more than 1,418,176 tons per annum, a large proportion of which is quite unfit for the purpose of gas manufacture.

Total Quantity of Cannel of all kinds Produced in 1865 *by all the Collieries in the United Kingdom, as ascertained by Mr. Robert Hunt, F.R.S., Keeper of Mining Records in the Government School of Mines in Jermyn Street.*

England	946,176	tons.
Wales	150,000	,,
Scotland	322,000	,,
	1,418,176	tons.
Of which there were used for distillation for coal oil	250,000	,,
	1,168,176	tons.

Note.—The above table, although referring to the year 1865, may be taken as fairly representing the yield of cannel of all kinds in the year 1875, with the exception, perhaps, of Scotland, where there may have been some increase. The quantity of cannel used by the metropolitan gas companies in the year 1875, for the purpose of enriching the gas made from Durham coal, amounted to 84,310 tons.

Purity of London Gas.

Passing from this subject to the question of the purity of gas, the author remarks that the maximum quantity of sulphur and ammonia allowed to be present in gas in London (no trace of sulphuretted hydrogen being permitted) is fixed, from time to time, according to circumstances, by three scientific gentlemen, selected and appointed for the purpose by the Board of Trade, who are called Gas Referees; and, in proof of the high position and qualification of those referees for the office they hold, it may be sufficient to mention that Professor Tyndall is one of them. The duty of ascertaining whether the companies comply with the requirements of the Acts and of the referees, both as to illuminating power and purity, is vested in the Corporation of London within the City, and the Metropolitan Board of Works outside the City; and both of these bodies employ skilled chemists of a high class to test the gas continuously day by day, whilst it is being delivered out for consumption, in testing-houses in various places about London, which the companies are bound to provide and fit up, at their own expense, with all necessary apparatus and appliances, and to give the requisite supply of gas for the purpose, free of cost. The penalties to which the companies are liable for any infringement of the standards, however limited may be the degree of excess, for any period of the day, are very severe; and it is further enacted, by way of additional torture, that every penalty which may be incurred shall not be payable out of the ordinary expenses of the company, but shall be absolutely deducted from the dividends of the shareholders. The public bodies referred to, whose disposition towards the gas companies cannot be characterized as amicable, are watchful beyond the possibility of evading them, even if it were desired, and they would apparently be only too happy if they could catch the companies tripping; but, in spite of their inclinations, they are compelled day by day to admit and certify, as they do, that the gas supplied is invariably not only equal to, but above the standard as respects its illuminating power, and several degrees below the maxima fixed for the impurities.

Main and Service Laying and Street Lighting.

As to the disturbance of the roadways in the streets, the most convenient and appropriate place in which the gas-mains might be laid is undoubtedly underneath the pavement of the side walks, as in most foreign cities; but in London, the cellars of the houses extend underneath the whole of the side pavements, the arches of which are so near the surface as not to admit of the pipes being laid between them and the pavement; and after any roadways may have been disturbed for the necessary main-laying, the local vestries refuse to allow the companies to make good the surface; they claim to do this work themselves, with a view, apparently, of making some profit out of the companies by so doing. The vestries, and not the companies, are therefore answerable for any defects in the restoration of the roadways, if such there be, after main-laying. The vestries are also responsible for all the odium which attaches to any defective lighting of the public thoroughfares; the companies merely provide and supply the gas, whilst the vestries determine the number and position of the lamps, as well as the size of the burner which regulates the quantity of gas to be supplied, and for which they are to pay; so that, if through the parsimony of the local authorities, the street-lamps are not sufficiently numerous, or the size of the gas-flame is not so large as it ought to be the companies are in no way to blame; they are, in fact, powerless to make it otherwise. Comparing London and Paris in this respect, it may be sufficient to state that in the former, the area of which is 77,997 acres, there are 54,119 public lamps, whilst in the latter there are 38,498 in an area of 19,299 acres.

Meter-Testing.

A very slight acquaintance with the mechanical contrivance of a gas-meter ought to satisfy any impartial mind that by no human ingenuity can it be wilfully driven onward, so as to oblige the consumer to take more gas than he desires, or to register more than he actually burns. If a meter errs at all—and every machine is to a certain extent imperfect—the liability so to err is in favour of the consumer. But the Legislature has not been unmindful of those who feel dissatisfied, and feel also disqualified to look into this matter for themselves; official inspectors of meters and official meter-testing offices are provided in several convenient places in the Metropolis, where impartial and skilled evidence may be speedily obtained at a trifling expense.

Official Audit of Companies Accounts.

With respect to the dividends and expenditure of the companies, it is evidently not generally known that the companies who supply the larger part of the Metropolis are placed under the active inspection of an official auditor, who is appointed by the Board of Trade for the express purpose of examining their accounts and of finding out whether any irregularity occurs. This auditor is

a very different person from the ordinary and often incompetent shareholders auditor, who readily accepts specious explanations and is willing to make things pleasant. The Government official takes nothing for granted; he likes his power, and uses it; he holds a continuous examination, and makes minute inquiry; he is armed with supreme authority to disallow any item he may consider improper, either in principle or detail, and he is actually authorized to prevent the declaration of any dividend which he considers has not been duly earned or is not lawfully payable. It is difficult, therefore, to conceive how more stringent precautions could be devised, or a state of things under which it would be more impossible for the companies to delude the public, even if they desired to do so, than under the existing law; and it may be added that the companies referred to, confident in their own integrity, willingly consented to submit themselves to these safeguards and precautions in favour of the consumer, in the hope that thereby they might disarm suspicion and gain confidence.

Rate of Increase in the Consumption of Gas.

The increase in the consumption of gas throughout London is fairly illustrated by the annexed table, relating to the extensive district of the Imperial Company, over a period of 25 years ending 1874, during which the annual consumption has increased fourfold, and the quantity consumed on the day of the greatest demand in each year, which, is always on the day preceding Christmas Day, has increased at a still larger ratio, being more than fivefold. It is for this day of the greatest demand, which, in the case of the Imperial, exceeds any other day by about two millions of cubic feet, that the capabilities of the several companies works must be prepared and maintained, and this of necessity involves the outlay of a very large amount of capital for works which are required for the service of this limited season of the year only.

Imperial Gas Company.

Table showing the Rate of Increase in the demand for Gas from 1850 to 1874 inclusive, over the same Area of Supply.

Year.	Total Quantity delivered during the Year.	Increase per Cent.			Largest Quantity delivered in One Day in the Year.
		One Year.	Five Years.	Ten Years.	
	Cubic Feet.				Cubic Feet.
1850	898,031,942	5·9	43·1	100·4	4,193,000
1851	984,631,416	9·6	41·9	112·0	4,866,000
1852	1,102,680,708	12·0	43·1	131·4	4,993,000
1853	1,236,861,400	12·2	52·1	149·6	6,178,000
1854	1,318,349,000	6·6	55·5	141·9	6,657,000
1855	1,460,391,000	10·8	62·6	132·7	7,531,000
1856	1,548,347,000	6·0	57·0	125·3	7,710,000
1857	1,608,306,000	3·9	45·8	108·7	7,800,000
1858	1,692,336,000	5·2	36·8	108·1	8,545,000
1859	1,808,960,000	6·9	37·2	113·4	9,811,000
1860	1,981,913,000	9·6	35·7	120·7	10,008,000
1861	2,038,887,000	2·9	31·7	112·3	9,662,000*
1862	2,153,909,000	5·6	33·9	95·3	11,203,000
1863	2,212,411,000	2·7	30·7	78·9	11,585,000
1864	2,463,989,000	11·3	36·2	86·8	13,087,000
1865	2,637,222,000	7·0	33·0	80·5	14,254,000
1866	2,838,701,000	7·1	39·2	83·4	15,724,000
1867	2,992,832,000	5·4	38·9	86·1	15,971,000
1868	3,019,000,000	0·9	36·5	78·5	17,023,000
1869	3,169,444,000	5·0	28·6	75·2	17,396,000
1870	3,364,524,000	6·2	27·6	69·7	19,603,000
1871	3,559,857,000	5·8	25·4	74·6	20,394,000
1872	3,661,583,000	2·9	22·3	70·0	19,953,000
1873	3,856,018,000	5·3	27·7	74·3	19,879,000
1874	3,998,659,000	3·7	26·1	62·3	23,352,000

* This falling off is attributed to the death of the Prince Consort, which occurred on the 16th of December in this year.

Note.—Five per cent. at compound interest = 63 per cent. in ten years.
Six " " " = 79 " "
Seven " " " = 96 " "

Supply of Gas to the Working Classes.

The author points out that the increase of consumption is still steadily going on, although the rate has fallen off somewhat during the last five years; there are, however, a very large number of houses yet to be supplied, especially those of the working classes. That class, indeed, in London do not, as a rule avail themselves of the use of gas in their dwellings, and by no means to the extent they do in the northern towns of England or in Scotland. For example, in the well-to-do parishes of Marylebone and Paddington, in London, the number of inhabited houses supplied with gas are 73 and 80 per cent. respectively of the whole number, whilst in Bethnal Green 27 per cent. only of the dwellings are thus supplied, and in the northern towns of England, as well as in Scotland, the number of one-light meters, which are essentially the poor man's meters, greatly exceed those used in London. Very few of the small dwellings in London indeed have any gas-fittings in them, the poor for the most part still use the common dip candle; or a paraffin lamp, when some manufacture is carried on which requires an extra amount of light; and yet it will be seen from a very interesting table annexed that, adopting the common standard of a sperm candle for comparison, the quality of gas now sold in London at 3s. 9d. per 1000 cubic feet, will give 52 hours of light for 1d., whilst dip candles at 6d. per pound will give only 5 hours and 45 minutes of the same light for that money.

Comparative Cost of Illumination by Different Lighting Materials in Common Use, showing the Hour of Duration for each Penny. The Light Reduced to Equal One Standard Sperm Candle.

Description of Material.	Price in London.	Hours Light for 1d.
Standard sperm candle . . per lb.	2s. 0d.	2h. 15m.
Best wax candle . . . . "	2 0	2 15
Sperm oil in moderator . . per gall.	9 6	2 24
Belmont sperm oil . . . per lb.	1 3	2 54
Stella or Burmese wax . . "	1 3	3 15
Petroline candles . . . . "	1 6	4 30
Composite candles, No. 1. . "	0 11	4 10
" No. 3. . "	0 8	5 30
Common dip candles . . . "	0 6	5 45
Almond oil in moderator . . per gall.	9 3	6 0
Colza " . . . "	5 0	9 15
Paraffin oil lamp . . . . "	3 0	19 11
Common gas . . . . . per 1000 feet	3 9	52 0

Note.—The writer states that he is indebted for the above table to Mr. George Glover, of the Ranelagh Works, Pimlico, the manufacturer of the celebrated dry meter, the experiments for which table were made under Mr. Glover's personal superintendence.

The working classes of London, therefore, require to be educated in this particular, among other things, relating to the economy of living, and it is satisfactory to notice that in the new dwellings for artisans, and in some of the model lodging-houses lately erected, the promoters of those excellent institutions are doing their best to this end by fitting the several rooms with the needful appliances, so that the occupiers may avail themselves of the cheapest mode of obtaining artificial light.

Transfer of Gas Undertakings to Municipal Authorities.

The closing remarks of the author relate to the question which has been the subject of much discussion of late—viz., whether it is desirable or not that the supply of gas should be taken from the companies and placed in the hands of the municipal authorities, and on this point he makes the following observations:—

The fact that the supply is of necessity a monopoly, that economy may be effected by uniting the districts of the companies into one, and that the roads which are occupied by the mains and pipes of the companies, are under municipal control, would seem to commend the proposal; and probably if London had been under the government of a Municipal Council worthy of the name, representative in its character, and possessing the confidence of the community, the gas supply would long since have been entrusted to that body. There are many precedents for so doing—several of the larger towns in England, and Manchester especially, may be referred to, where the duty has been most efficiently performed by the municipalities for many years; and there is no reason why a competent committee of a Municipal Council in the Metropolis could not conduct the operations now fulfilled by the directors of the several companies with equal skill, although, if proof is needed that the task is not beyond their powers, certainly no such enormous undertaking, as that involved in the manufacture and distribution of gas for the whole of London, is to be found elsewhere.

The companies can have no desire to retain the work in their hands, if the municipality desire to acquire their undertakings, provided that their property is fairly purchased, and the transfer is effected on equitable terms. The shareholders in those companies are, however, greatly alarmed, and naturally apprehensive, at the views which the authorities have expressed as to what they consider to be equitable terms for a compulsory sale. In a letter from the late chairman of the Metropolitan Board of Works to Sir Stafford Northcote, as President of the Board of Trade in 1866, when the former was requested to communicate to the Goverment the opinion of the Metropolitan Board as to the terms upon which authority should be given to the Board to purchase the property of the companies, he deliberately states, "that looking at the present market value of the gas shares, and to the fact that their (the companies) security is an uncertain one, the Board resolve that it would be fair and proper that the bill for the purpose of purchase should provide for the enforced sale of the properties of the companies by the payment to the shareholders of a dividend of only 6 per cent." Now the properties referred to, it will be borne in mind, were then earning and paying authorized dividends at the rate of 10 per cent., and they had been doing so with regularity for many years previously; and in an earlier part of the same letter the chairman of the Metropolitan Board gives it as the reason for requiring an alteration of the then existing law, that the operation of that law "practically secured to the companies a guaranteed dividend of 10 per cent."

Again, as lately as last year, the bill promoted by the Metropolitan Board for power to purchase compulsorily the undertakings of the companies, proposed that the price to be given for the same should be the average market value of the shares of the companies during the three previous years, throughout the whole of which period it was notorious that the violent agitation which had been raging against the companies had had the effect of depreciating the value of their shares from 30 to 40 per cent. The case of the Imperial Company may be stated as fairly illustrating the mode in which the shareholders in all the companies would have been dealt with under this proposal. The average price of the Imperial Company's stock during the three years selected for the average was little more than £166, but the price at which the same stock was freely selling in the market shortly before the bill was brought into the House was about £182, and since the agitation has abated, the price has risen to upwards of £200.

These are the only occasions on which the Metropolitan Board have openly and officially stated what they consider to be equitable terms for a compulsory purchase of the undertakings of the London gas companies—terms which, it is scarcely needful to say, do not accord with the views of the shareholders, and which they fully believe the Legislature will never compel them to accept, notwithstanding that the sacrifice of the property of the comparatively smaller number of shareholders for the benefit of the much larger body of consumers has met with, and, perhaps, will always meet with, a certain amount of support both in and out of Parliament.

Professor Leone Levi asked what economy would be effected, if the municipal authorities were to purchase the whole of the interests of the gas companies? What was the total amount expended in the offices, in directors fees, salaries of clerks, and others, and how much of that would be economized by the administration being confined to one body for the whole of London? He imagined that a great deal of waste occurred now, owing to there being so many companies; and, if he were well informed, the Manchester Corporation were producing and selling gas at a cheaper rate than the London companies did. What economy was effected by the Manchester Corporation? The paper, he said, did not give them an opportunity of comparing one administration with another; and the reader of the paper assumed that the companies worked with a guaranteed dividend of 10 per cent. The question resolved itself into a consumers question. The paper was entirely from a monopolist's point of view. He doubted very much whether the consumer was benefited by the present state of things, but they had not the materials by which they could judge the effect of the change to which he had alluded. The paper, however, was very useful; but it did not contain the necessary elements to render discussion fruitful, and he suggested that Mr. Chubb should give them some additional data.

Dr. Farr, alluding to the table, giving the dividends paid by the companies since 1812, asked whether they were to understand that the Chartered Company paid no dividend from 1812 to 1817. Could Mr. Chubb continue the paper, and give the dividends paid since 1840?

Mr. Patterson thought the addition of a few more statistics would be most valuable. Alluding to the recent amalgamations, he said he could not see how efficiency of management was to be increased by the amalgamation scheme. He was sceptical as to whether the directors would manage twice as much more efficiently than before. One advantage was plainly possible—that, by shutting up badly-situated works in London, they would have economy, as they would take the works to places where the coal could be better supplied. He did not look forward to any economy from the mere amalgamation of administration; and, if the municipal bodies expected any gain in that direction, he did not believe their anticipations would be realized.

Mr. Chubb, in reply, said Dr. Farr was quite correct in saying that the second table stated that no dividend was earned by the Chartered Company from 1812 to 1817. They paid no dividend till 1817, when the first dividend paid was 6 per cent. They then earned 8 per cent., and from 1826 it became pretty nearly 6 per cent. In 1860 they paid 10 per cent., and since then almost uniformly 10 per cent. Although it was complained that it was a guaranteed dividend, yet it was, in fact, guaranteed, and the money was invested on that condition. It was a condition upon which the money was raised, and the shareholders expected that faith would be kept with them. He had not the least objection to admit that, to a certain extent, the paper was written from the

companies point of view; but he had endeavoured to remove some of the prejudice against the gas companies. He had no objection to say what amount was expended in salaries. The salaries of the directors and auditors of all the companies amounted to ·40d. per 1000 cubic feet, and those of the whole staff of clerk and secretaries connected with the companies amounted to ·45d. The amount was large in each case; the directors and auditors absorbing £20,000, and the officers £23,690. He had endeavoured to post himself carefully up to the end of last year; but the accounts of the companies were not all complete. Manchester had been alluded to as a case in which comparison might be made. Manchester undoubtedly sold better gas than they, and for a less price. He thought the price was 3s. in the city, and 3s. 6d. outside. Manchester, however, stood on the borders of the Wigan coal-fields, and they got their coal at much less cost, and they had a sufficient supply. For many years Manchester charged more than they did in London. They were charging 4s. 6d., when Manchester was charging 6s. At that time they used all their surplus profit to pay off their capital; they had reduced their capital year by year, till now they had very little capital on which to pay, and they had raised their capital at 4 per cent. The same remarks applied to many of the companies in London; some had charged a large price, and spent their money in increasing their plant, instead of raising capital for the purpose. The South Metropolitan Company were able to sell gas at 3s., which other companies wanted 3s. 9d. for, and the "reason why" was a constant question. They, however, only wanted 11d. per 1000 to pay their dividend, whereas the other companies who had not so reduced their capital wanted 1s. 3d. One company only wanted 9d. per 1000. But there were special circumstances in almost every company which really required explanation, and which affected the price at which they could supply gas. It was not the mere economy of working; there were other circumstances. It had been asserted that the supply of gas was only a consumers question; but that, he thought, could hardly be the case. There were two sides to every question. The Metropolis Gas Act of 1860 was the general Act, and undoubtedly that Act practically guaranteed the companies 10 per cent. The Act stated, in effect, this—that if the companies supplied gas to every one who demanded it, gas of a certain quality, and subject to penalties if of less quality, they should be authorized to charge a price so as to pay 10 per cent. on their capital, and put by a reserve-fund to equalize their dividends. It was complained of by the Metropolitan Board of Works; but, practically, it amounted to a guaranteed dividend. Since he had written his paper, the two largest companies and a smaller one—the Chartered, the Imperial, and the Independent—had been amalgamated, and they had accepted a modification of the scheme—that the dividend should rise and fall with the price. If they could make a dividend at that price, they might have it; if they reduced the price of gas one penny, they might have a quarter per cent. more; and if they increased it one penny, they would have a quarter per cent. less. He had gathered a great many more statistics, which might be added to the paper.

Mr. HYDE CLARKE said from the paper they might be inclined to believe that gas was absolutely opposed in the first instance by men of science, but a more careful perusal showed that this was not so. It was possible they might be clearer on all points, if Mr. Chubb would give them the further particulars he had acquired. It should be remembered that a great deal of the opposition made to the introduction of gas was owing to many of the statements and proposals of Mr. Winsor, the inventor; and as to the present price of gas at 3s. 6d. and 3s. 9d., he reminded the meeting that at the time of which he was speaking the price of gas per 1000 feet was 28s.

Mr. G. LIVESEY said he had not quite made up his mind to say anything on the occasion till allusion was made to the South Metropolitan Company, but he felt bound to contradict the statement which had been made. The South Metropolitan Company never charged a higher price than their neighbours. Previous to 1848 there was competition all over London, and that being the case, all the companies were obliged to charge one price; so that previous to that year, it might be said that the price of gas throughout London was uniform. At that time the price was 6s. generally. Sir John Thwaites, who at that time resided in the Borough, undertook an agitation to get the price reduced to 4s. The gas companies, instead of listening to the demand, said, "We will make no reduction," the companies being led by the chairman of the City Company. The upshot was that the Great Central Company was started in the north of London, and the Surrey Consumers Company in the south, and the result was a reduction from 6s. to 4s. In 1853 it was found that competition would not do, and the companies adopted the system of dividing the Metropolis into districts. He believed the honour of suggesting that arrangement was due to Sir John Thwaites, and it had proved very beneficial. The Surrey Consumers Company were about "on their last legs" at that time, and the reduction of price from 6s. to 4s. reduced the South Metropolitan Company's dividend from 6 to 5 per cent. Immediately on the division into districts, however, the dividends of the companies began to rise. During the last 25 years the price of gas had not fallen so much. From 1850 to 1860 the City was supplied at 4s.; the price was now 3s. 9d., and the quality was not much better, what improvement had taken place was more an improvement or alteration of the burner employed. As to the great question which was being agitated at the present moment—the question of the sliding scale—he felt that it was based on ground which was fair both to the consumers and the gas companies. He could not see the justice of gas companies being absolutely guaranteed 10 per cent. dividends. They were given a certain monopoly, and the fact of that monopoly and a fixed charge gave them a practical guarantee of 10 per cent. He could hardly think it was the intention of the Legislature to give absolutely 10 per cent. As to the sliding scale, he contended that it was not fair in such a crisis as the gas companies passed through lately, when coal went up enormously in price, that the whole burden of the extra price should be thrown on the consumer. During that time, however, the gas companies did not diminish their dividends at all. Although a gas man, he could not help saying that the gas companies charged a higher price than they ought to have done during that period. Previous to the coal famine the Neath New Gas Company were limited to 3s. 6d., as was also the Brighton and Hove Company; but when the coal famine came on them, this price was found to be very hard. These two companies, therefore, went to Parliament to get powers to charge a higher price, but their dividends were cut down from 10 per cent. to 5 per cent. Well, the price went up in their cases for one year to 4s., but at the expiration of the year it fell again to 3s. 6d. He thought that in their case the cutting down of the dividends from 10 per cent. to 5 per cent. was very hard, but he did think that the sliding scale was most fair. The only objection he had seen urged against it was, that if the companies could earn under it 12 per cent., for instance, there would be a renewal of the outcry against them. He, however, believed that if the public got what they considered cheap gas, they would not care what dividends the companies paid. Mr. Chubb had alluded to the case of Manchester, and the case of the working classes in the northern towns. It appeared from the accounts of the Manchester Corporation, that of the 60,000 meters they had fixed last year, upwards of 30,000 were for two lights each, thus showing that half of their customers belonged to the working classes. It had not been the interest of the London companies to get the custom of the working classes. Supposing they could increase their business by increasing the area, he should not mind having 1 per cent. of bad debts instead of a half per cent. As to the Government auditor, he was bound to agree with what Mr. Chubb said, but he felt that not all the auditors in the City of London could be of real service in seeing into everything, as the Government auditor did. Let it be to the companies interest to keep down their capital, and serve their customers well. A good deal of the capital of the South Metropolitan Company was originally wasted; but the company paid from 1840 to 1850 a dividend averaging 6 per cent., and used the surplus profits in recovering the lost capital. He maintained that the capital in the South Metropolitan Company was as much as it ought to be, but to say this had been brought about by charging the consumer a higher price was not in accordance with the fact. The advantage of municipal management of gas-works, would principally arise from the fact of corporations being able to raise new capital required at about 4 per cent.

Dr. FARR expressed his opinion that it would have been advantageous if the Metropolitan Board of Works had taken the supply of gas and water in their hands. He hoped Mr. Chubb would kindly tell them the amount of capital employed by the companies since 1840, and also the dividends paid by the companies down to the present time. Taking the capitals of the London gas and water companies together, they probably amounted to £21,000,000, the profit divided upon which was about £1,600,000. Now if the Metropolitan Board could raise capital for the purchase of these undertakings in the way suggested, there would be a saving of £800,000 per annum, which was now a positive tax on the consumers. In any arrangements for a transfer of the works, the most perfect justice should be displayed towards the companies and their officers.

The Rev. Mr. DOXEY said it appeared to him that the chief advantage which would, *primâ facie*, result from the Metropolitan Board of Works having these matters in their hands would be bringing the interests of the consumer and the supplier in perfect harmony. While the interest of the companies was obviously one thing, the interest of the consumers was another. How far the new arrangement referred to would bring them into harmony he could not say; if, however, the Metropolitan Board of Works had bought up all the companies there could have been no competition and no advantage at all in charging more than the cost of coal and the expenditure in manufacture. If Mr. Chubb would consider these points in completing his paper, he thought they would be under still greater obligations to him.

Mr. HEADLEY said he had for 20 or 30 years advocated the adoption of the sliding scale. Some companies were managed better than others, and he considered the great blot on the present system of legislation was that it gave all the companies, whether badly or well conducted, the one maximum dividend. The London Companies had, he asserted, only been liberal, as they had been compelled to be liberal. The one cry of the companies had been, "The price of gas cannot be reduced," but as soon as one company reduced the price every other company followed. By the adoption of the sliding scale the public would, he believed, soon see a very considerable reduction in the price of gas. In the case of the London Gaslight Company, he knew that the first two or three issues of their capital were entirely wasted, and the consumers in that part of London, supplied by that company, were now paying 10 per cent. interest on works now of no use to them. The £50 shares of that company, which now were selling at £87, were to be bought 30 years ago at £2 per share; and on those £2 shares people were now getting their 10 per cent. As to the illuminating power of the gas, it was worse now than it was 20 years ago. The burner by which they used to test the gas formerly showed that it was equal to 12 candles, but, by an improvement in the burner, gas now called 15-candle gas was, ten years ago, called 12-candle gas. Instead of the illuminating power of the gas in London having improved, a certain improvement had been effected in the burner by which its quality was determined.

Mr. SMEE asked whether it was not a fact that Parliament practically granted a statutory dividend of 10 per cent., and if the committees who fixed the price of gas did not find their hands tied, because they were obliged to give the companies 10 per cent. dividend? Speaking as a chemist, he thought the companies were quite justified in providing the best burner they could.

Mr. MILLAR asked whether they could not have some later information about the production of cannel coal than since 1865.

Mr. CHUBB, in further reply, said he thought that Mr. Livesey would admit that the South Metropolitan Company had employed revenue for capital purposes. The fact was, their capital having been thus reduced, they had been able to charge a less price for gas than other companies. This certainly placed them in a position of advantage and popularity with the public, but it was rather injurious to the other companies. Still, he very candidly admitted that there had been defective legislation in many respects towards gas companies, and many of them had not been "wise in their generation." When, however, Mr. Livesey said the Great Central Company brought the price of gas down, he ought also to have said that the companies, for a time, paid no dividend as the result. He admitted that he ought to have added, and might add, many more tables to his paper, showing comparisons, giving the information asked for, and making them more complete. With respect to the remarks as to the burner, and the gas now being no better than it was many years ago, he might state that the burner, many years ago, was not defined; but he thought it could scarcely be said that the gas was not better than it was 20 years ago, in respect to illuminating power and price, and it was tested now most rigidly. No doubt, at the beginning of the history of the companies, there was a good deal of waste of capital; but he thought the expense of some of the experiments should be borne by the public. Many of the objections to the old legislation, in reference to the gas companies, were met in the bill of the present session. All future share capital was to be put up to public competition, and all premiums obtained by its sale would be so much in reduction of capital, because it would bear no dividend. The burner was also defined accurately in this bill. As to the remark about the amount of sulphur and ammonia present in the gas being greater now than formerly, the fact was that Dr. Letheby had discovered means by which a greater amount of sulphur could be detected now than by the old apparatus.

The CHAIRMAN, on the conclusion of the discussion, conveyed the hearty thanks of the meeting to Mr. Chubb for his excellent paper, and the meeting separated.

GAS FROM WOOD AND CRUDE PETROLEUM.—The gas company of Geneva, U.S., intend manufacturing gas from wood and crude petroleum instead of coal. It is asserted that the gas thus produced gives as pure and brilliant a light as coal gas, and can be made and supplied to customers at greatly reduced rates.—*Engineer.*

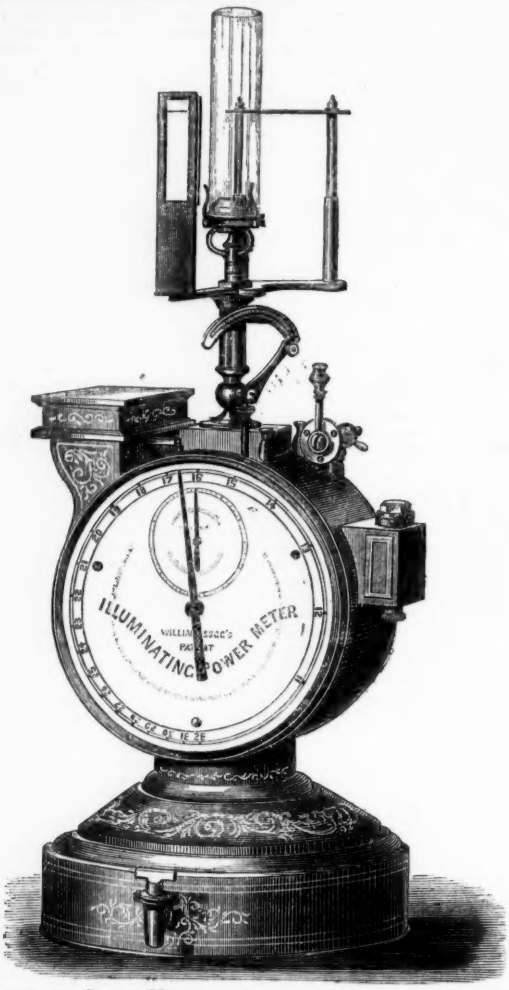
RIPLEY SEWAGE AND WATER SUPPLY.—A Local Government Board inquiry has just been held at Ripley, on the application of the local board to borrow £17,515 for the above purposes. It is proposed to supply 6500 people with water, from a reservoir capable of holding 270,000 gallons. The daily supply will be equal to 110,000 gallons, or 12 gallons per head per day. With reference to sewage, the proposed plan embraces the northern, southern, and western districts of Ripley. For the northern part an offer has been made to lease 31 acres to the board for sewage purposes. As regards the southern part, the board asked for compulsory powers. The sum of £10,150 is required for sewage, and £9500 for water-works; a portion of the latter sum having already been obtained from the Public Works Loan Commissioners.

NEWBURY GAS SUPPLY.—The Newbury Gas Company hold their works on lease from the corporation of the town, and their present term has only about two years to run. Finding that the demands upon them for gas exceed the capacity of their works, and that the expenditure of a considerable sum of money for extensions will shortly be necessary, the company recently addressed a letter to the corporation, asking whether, at the expiration of their lease, the council contemplated the acquisition of their works. At the meeting of the Town Council on the 11th inst., the committee appointed to consider the matter reported that, having regard to the satisfactory results which have followed in the very numerous cases in which local authorities have taken over the management of gas-works, it is not expedient to renew the lease to the company. After some discussion the report was adopted.

SUGG'S ILLUMINATING POWER METER.

In February last, Mr. Sugg read a paper before the Institution of Civil Engineers on "Estimating the Illuminating Power of Coal Gas," and we are indebted to that gentleman for the following description of the illuminating power meter which he then exhibited.

This instrument has been designed by the inventor principally for the purpose of aiding engineers in the examination of coal, and other substances suitable for gas-making. It is intended to test the illuminating quality of all gases under similar circumstances, and to show the relative commercial value of these gases to the consumer.



ILLUMINATING POWER METER, FOR SHOWING THE ILLUMINATING POWER OF GAS IN PARLIAMENTARY SPERM CANDLES, BY THE OBSERVATION OF ONE MINUTE.

The annexed engraving shows the appearance of the instrument, and the following is a description of its construction and the mode of using it:—

A "London" Argand burner, provided with a well-made cylindrical chimney, is fixed, by means of a ground swivel joint, on the top of a pillar screwed on to a hollow rectangular base, which is firmly soldered to the outer case of an experimental meter. This base has no communication with the inside of the meter-case. That part of the pillar between the top of the base and the burner forms a cock, the gas-way of which is not drilled in the usual manner, but is slotted across the plug. The sides of this gas-way being parallel to each other, it follows that, unlike those cocks fitted with round-way plugs, the cock opens when the lever is turned by regular gradations until it is full open. A quadrant, divided into 45 equal divisions, attached to the cock, enables the operator to regulate the flow of the gas to any required rate with rapidity and precision. Above the quadrant a sighting frame is fixed, having two upright pillars, crossed by a flat bar at one end, and at the opposite end a frame fitted with blue glass. A scratch is made across the glass exactly three inches above the solid part of the frame. The bottom of the opening, the top of the burner, and the termination of the thick part of the back columns are all on the same level. The scratch on the glass, and the bar which crosses the back pillars, are also on the same level, and parallel to the three lower points just mentioned. By these arrangements the operator is enabled to adjust the height of the flame to the level of the scratch and the back bar.

It may be observed, in passing, that if some points in the flame pass the line by about one-eighth of an inch, it will make but a very slight difference to the result. There will always be small points which will look like flame, but which are only heated air. A few minutes practice will suffice to enable any one, without previous knowledge of the instrument, to adjust the height of the flame.

On the left side of the hollow base on which the pillar stands is a tube which connects this base to the outlet of a double governor. The square box on the left of the meter is this governor, which serves to maintain uniformity of pressure during the time the instrument is in use. This governor is adjusted so as to give pressure enough to make the flame tail over the chimney when the regulating-cock is full open.

On the right of the hollow base is fixed a two-way cock, with a lever ending in a knob fixed to its plug. The cock is quarter stopped, so that when it is turned in one direction as far as the stop it is full open, and in communication with the inside of the meter, which is full of measured gas. In this position this measured gas passes through the length of the plug of the cock, and by means of a tube fixed to the end of the cock at one end, and to the inlet of the double governor at the other, it finds its way through the governor to the hollow base, and finally to the burner. While the gas is passing to the burner by this route, the measuring-drum of the meter revolves; but if the lever of the cock is turned in the opposite direction until it meets the stop, another route is opened for the passage of the gas. Now it passes directly from the inlet of the meter without passing into the measuring-drum, through the length of the plug of the cock, and out by the same tube as before to the inlet of the governor, thence to find its way to the hollow base and the burner. In this position of the lever the measuring-drum of the meter is at rest, and the gas is unmeasured. The governor having been properly adjusted, and the meter having from 8-10ths to one inch of pressure at its inlet, this change in the position of the lever will not influence the height of the flame.

The index-hand is attached to the arbor of the measuring-drum, and therefore revolves with it, both making a revolution in the same time. The dial is divided into a number of divisions corresponding with the illuminating power in average parliamentary standard sperm candles, of the different qualities of gas which will give a flame of 3 inches in height. Thus, if the meter is supplied with 16-candle gas, and the flame is maintained at 3 inches, the index-hand will make one complete revolution in one minute. If the meter is supplied with 12-candle gas, and the flame maintained at the 3-inch line, the hand will make one revolution, and a part of another, arriving at the figure 12 in one minute. With 20-candle gas it will make less than a complete revolution in one minute, and arrive at 20. The instrument is provided with a very accurate and strong minute clock, with one pointer hand, which makes a complete circuit of the small dial in one minute. This dial is divided into 60 equal divisions, representing seconds.

On the right of the cylinder which forms the outside case of the meter is the water-line gauge, fitted with back and front glasses. At the correct water-line these glasses are scratched across. On the top of the water-gauge is a large nut, which can be unscrewed when it is required to fill the meter or clean the gauge-glasses. The plug at the lower part of the gauge is for the purpose of running out the water if there is too much in the meter.

In the base of the meter is a cock for the purpose of emptying all the water out of it, when it is requisite to do so. This meter should never be turned upside down for the purpose of emptying, or some water will get into the governor and connexions, and probably cause trouble. For the purpose of filling the meter, a solution of one part of good glycerine, free from acid, in three parts of distilled water, should be used.

The mode of putting it into operation is very simple. Having filled the meter up to the water-line scratched on the glass, connect it to the gas supply with a piece of metal tube. The inlet is a ground union joint, fixed in the centre of the back of the instrument. Turn the lever so as to make the gas pass through the measuring-drum, and let it get rid of all the air or other kind of gas in it. Light the burner and adjust the flame to 3 inches in height. Then, when the large hand arrives at 16, change the position of the lever, so as to make the gas pass to the burner without going through the measuring-drum. The large hand will then stop at 16. Wind up the clock by means of the *remontoir* on the top of the meter just in rear of the dial ring. Start the clock by moving the slide which is on the left of the meter, close to the governor. Then, when the hand of the clock is passing any one of the divisions of the minute, change the position of the lever of the bye-pass, so as make the gas pass through the meter. When the minute hand has made one complete revolution, stop the meter by means of the lever, in the manner before described, and read off the illuminating power. The minute clock should not be stopped either before or after the observation, unless it is desired to put the clock entirely at rest.

Referring to the abstract of the paper on estimating the illuminating power of coal gas, read at the Institute of Civil Engineers, and published in the JOURNAL OF GAS LIGHTING of Feb. 22 last, it will be seen that it is very difficult, according to the present system of testing for illuminating power, to arrive at a just appreciation of the relative value for lighting purposes of different qualities of gas made from different mixtures of coal. The various standard burners differing one from the other in almost every point, coupled with the uncertain light-giving power of the standard sperm candles, tend to impede, and in some cases entirely to prevent the carrying out of any really useful comparisons.

Of course, these difficulties are not generally so apparent when it is a question of verifying the illuminating power of gas supplied to the public under the usual parliamentary conditions. Custom has established that the variations between the tests made by the public officer at his official testing-place, and those made by the seller of gas at the gas-works, may be considered to range between one and two candles. And this is set down as resulting from various causes. So that it is generally assumed that if the gas is sent out of the gas-works two candles more in illuminating power than that stipulated for in the Act of Parliament or contract, the seller is in no danger of falling under the pains and penalties to which he is liable whenever the illuminating power is found by the official examiner to be below the standard. Proofs are not wanting, however, that this mode of ensuring against accidents is not an infallible one. Probably, it would be safe enough if it could be at all times certain that the gas is really sent out two candles over the standard. But in many cases the testings made at the gas-works are done by comparison with sperm candles. The errors caused by the different degrees of illuminating power per grain of material consumed given by different candles, are sometimes in favour of, and at other times against, the gas. If, therefore, these errors are in the same direction on the same day at the gas-works and at the official testing-station, there will, in all probability, be some accord between the two operators. But, on the other hand, they may go in different directions, and then the results will be very conflicting.

Both parties having made the experiments carefully, it becomes a matter of extreme difficulty to decide which is right. Not even a strict examination of the details of the experiment, will avail in some cases to afford any clue to the discovery of the error. The causes which have led to the discrepancy may be these—the gas at the works may not be properly consumed in the standard burner, and the candles may be giving more light per grain of material consumed than they ought. The introduction of a small quantity of paraffin or petroleum into the sperm, or the diminution of the quantity of wax which is always mixed with sperm to prevent it from crystallizing, or, as it technically termed, to break the grain, will certainly do this. This combination will make the gas appear to be of a lower quality than it really is. But upon its passage from the work, to the testing-station, if the movement is slow, some of the illuminating agents in the gas will be deposited in the mains, and there will be some loss of illuminating power. Under such circumstances, the official test ought not to show so high a result as that taken at the works. But the official burner, of which that at the works is a copy, will be better able to burn the stipulated 5 cubic feet of poorer gas to advantage than that at the works could the richer; and, if the official candles happen to give a light nearer to the ideal standard than those before mentioned, it is certain that the gas examiner's estimation of the gas will be higher than that of the seller. From such a cause, perhaps, arises the curious circumstance of an apparent increase of illuminating power in the passage of gas from the works to the testing-office. A variation in some of these circumstances in other directions may lead to a result nothing like so agreeable, and a considerable diminution of illuminating power may be observed on another occasion at the same testing-place at which the opposite result has been recorded. The gas, however, may be quite equal in quality to that which was in the first instance so favourably reported upon. On the other hand, the seller may be deceived in his examination of the gas he is sending out of the works by candles which give less light per grain of materal consumed than they should, and thus be led to suppose that it is better than it really is. Bad cotton, or even good cotton badly plaited, or the admixture of stearine

with the sperm, or an extra quantity of wax—all very difficult to detect—will produce this result.

In all cases when the gas going out from a work is tested by means of a Lowe's jet photometer, the engineer is enabled to check these irregularities, and to ascertain, with a very great degree of certainty the real value of the gas he is supplying to the public. But the official examiner has no such aid, and he is quite unable to determine whether the results he obtains are correct or not. Naturally, so long as the gas arrives at the testing-station two candles above the stipulated quality, the probability is that he will not find it to be below the parliamentary standard. But if he does, and makes complaint of it, then comes the difficulty. A comparison of the testings at the gas-works with the official tests must be made.

It has been proved, on several occasions, that the gas which had been found by the official test defective in illuminating power, has shown itself above, and sometimes considerably above, the parliamentary standard by the indications of the identical jet photometer, which, on most occasions before, agreed reasonably well with comparison test made at the works, and that by the official examiner. Doubts are entertained, therefore, by both parties as to the value of each other's experiments, when really, from the careful manner in which the tests have been made on both sides, there ought not to have been any discordance in the results. It has been suggested that if the official testing apparatus included a Lowe's jet photometer, much difficulty would be obviated; because then the official tester would be able to check the results obtained by the comparison photometer, and could try over again, with other candles, any experiment which in the result disagreed with the observed illuminating power shown by the Lowe's jet photometer. The goodness of this suggestion has been, in those cases in which it has been acted upon, satisfactorily demonstrated; and the official examiner has been enabled to detect erroneous results by means of this check. No notice, however, is ever taken in official returns of the indications of the jet photometer, because it has never, in this country, been sanctioned as a parliamentary test, and no mention of such a mode of testing has ever been made in any Act of Parliament. Perhaps the time may come when it will be deemed advisable, in all gas Acts, to provide a check test for the illuminating power of gas, in addition to the usual specification of the testing-burner and parliamentary candles. When that time does come, the jet photometer or the illuminating power meter may be advantageously adopted for the purpose.

This last-mentioned instrument is of immense service to the jet photometer, because by it the accuracy of the latter instrument can be verified, at all times, in another way than by comparison with a standard Lowe's jet photometer; and, what is of still greater importance, the indications of the jet can be put in direct comparison with other systems of ascertaining illuminating power in a manner more certain and satisfactory than has hitherto been attainable. The great difficulty which has always prevented the strict accordance of the tabulation of the indications of illuminating power, as shown by the jet photometer, with the results of experiments conducted by means of comparison photometers, has been, up to the present time, the variations in the standard burners made use of. These remarks more particularly apply to gases above or below 14 candles, as tested by the Sugg-Letheby burner.

The general adoption of this burner for testing 14-candle gas permitted of the accurate adjustment of the jet for the estimation of this quality of gas. By taking the average of a great number of experiments with different sperm candles, a mean of illuminating power was found, which agreed very nearly with the results of independent experiments conducted by M. Le Blanc, the chief municipal gas examiner of Paris. It was, therefore, assumed that, when a jet of fixed dimensions furnished a flame of 7 inches in height, under a pressure of 0·63 of an inch of water, the gas which was able to supply this flame was equal to 14 average sperm candles, comparison being made with 5 cubic feet of gas consumed on the Sugg-Letheby burner. This assumption has been considered as well founded by numerous independent experimentalists in various parts of the world, who have made use of Kirkham and Sugg's improved Lowe's jet photometers thus rated.

The adoption of the "London" burner by the Metropolitan Gas Referees led to the abandonment of the Sugg-Letheby burner, as a standard testing-burner, in most of the cities and towns throughout the world where it had been in use, and to the substitution for it of that adopted by the Gas Referees. This change affected the position of the 14-candle line on the jet photomoter chart, and another line had to be found for it, which was very easily done. But, after quitting the 14-candle line on the chart, the comparison of the Lowe's jet with the results obtained by official examiners, working under the various Acts of Parliament, becomes much more difficult. The reason is, that there is no regularly adopted series of standard burners which develop a *pro ratâ* amount of light, in comparison with the Gas Referees "London" burner, per cubic foot of gas consumed. The three 16-candle standard burners described in Acts of Parliament differ amongst themselves considerably, and there is only one 18-candle burner, but this is not in any better case, as regards comparison with the Gas Referees standard burner for 14-candle gas.

These exhaust the list of standard Argand burners. For 20-candle gas, flat-flame burners are made use of, and two entirely different burners of this kind have been sanctioned by Parliament—viz., that adopted by the Gas Referees, and which is called "Sugg's No. 7 steatite bat's-wing," a slit burner, and the Dublin fishtail, or double-current burner. The former of these consumes the gas at 2-10ths, and the other at 5-10ths of an inch of water at the point of ignition. Our readers need not be told that the results obtained by their aid differ wldely. Beyond 20-candle gas there are no recognized standard burners.

Mr. Kirkham and Mr. Sugg, in making their experiments for the purpose of establishing a comparison between the readings of the jet photometer and the parliamentary tests, were obliged to make burners which would consume 5 cubic feet of the different qualities of gas, and their improvised test burners accorded very well with each other; hence the regularity of the scale. But they laboured under the disadvantage of not having so full an acquaintance with the principles which rule the development of the latent luminosity in gas as they now possess, and, therefore, although they quite established their belief in the principle, that all quantities of gas could be made, by the aid of proper burners, to develop a *pro ratâ* amount of light per cubic foot of gas consumed, they did not succeed in carrying their ideas into practical effect to such an extent as they desired. But upon the experience gained in these experiments are founded the ideas which led to the construction of the illuminating power meter, in which it is sought to provide a means of more correctly estimating the light-giving power of gases, and to compare them with each other without having recourse to the doubtful aid of candles, and with only one standard burner for all qualities of gas. But even this wholesale sweeping away of troublesome elements does not completely clear the ground for fresh operations. The estimation of gases up to 18 candles has always been made by the aid of Argand burners. The 10 and 12-candle burners of the times preceding 1850 were Argands; the Sugg-Letheby of 1863, for 14-candle gas, the Dublin, for 16-candle gas, and the Leamington, for 18-candle gas, are also Argands. But for gases of 20 candles and upwards, the rule has been to employ a fishtail or flat-flame burner. Here is a difficulty. Gas which is 20-candle gas when tested by a flat-flame burner, is about 18-candle when tested by such a burner as the Gas Referees "London." But if the edge and flat of the flat-flame be alternately presented to the disc, and a mean result of the light given from both positions taken as the true illuminating power, it will be found to be a little over 18 candles.

Again, if gas which has been tested and found to be equal to 18 candles by the Leamington Argand burner (15 holes, with steatite top and 7 inch by 2 inch chimney) be again tested, the Gas Referees cannel flat-flame for 20-candle gas having been substituted for the Leamington burner, the result will be about 22 candles. The reason for this is that the Leamington burner does not develop the illuminating power of the gas supplied to it, and, in consequence, if it is required to give gas equal to 18 candles measured by this burner, a mixture of coal must be put into the retorts which is capable of producing gas which will give the light of 22 candles per 5 cubic feet, measured by the Gas Referees standard flat-flame burner for 20-candle gas. Mr. Sugg has endeavoured to meet this difficulty by fixing upon the illuminating power meter a Gas Referees "London" burner, with a modified form of cone and chimney-holder, which permits of three currents of air being supplied to the flame. The object of these modifications is to permit the flame to burn in the chimney in a current of air sufficient to supply it with a proper quantity of oxygen for its combustion, without permitting the chimney to draw in too much air against the flame itself, or in other words to decrease the rapidity of the column of air moving up the chimney to such a point as will be sufficient to keep the column of flame upright, and leave the burning gas to take the quantity of oxygen it requires in a natural way. The effect of this modification is to develop the illuminating power of the gas to a greater extent than is done by the Gas Referees "London" burner.

Such burners are made for and extensively used by consumers, and are not made for testing purposes at all. If one of these burners is used as a test-burner for 20-candle gas, the results are equal to those obtained when the Gas Referees flat-flame burner is used, although for 27 to 35-candle gases they fall a little below the results arrived at by the use of large flat-flame burners. But it is only fair to say that as these burners are generally very smoky, no consumer could burn gas in that way; besides which, the results obtained are fictitious, because only the flat of the flame is presented to the disc.

If a flat-flame burner is used for testing gas, and the flat of the flame always presented to the disc, the graduation of the photometer-bar ought to be arranged accordingly, in order that the results obtained may correspond with those arrived at in testing gas of 18-candle power and under. In these latter experiments a standard is made use of, which gives light equally in all directions, in conformity with the principles upon which the calculations for dividing photometer scales are based.

It may reasonably be asked why gas of 20-candle power and upwards should not be tested in the same manner as qualities below that standard. The illuminating power meter, as the inventor proposes to use it, with only one burner and a 6½ inch chimney, will be found to give a rather more favourable result for gases of 12 to 18 candles, and a less favourable one for those above 20 candles, comparison being made with some of the modes at present in use for testing the light-giving power of these gases. But, *per contra*, all the gases will be tested in the same manner, and as the private consumer can use them, and the amount of light given will be in volume and intensity such as to thoroughly satisfy him. At the same time the instrument will afford a fair indication of the result which would be obtained, were any of the gases tested in accordance with the usual practice, and with the aid of any of the present legal standard burners.

On the dial opposite the number of candles of illuminating power, corresponding with the result which these several burners would show, will be marked a star, designating the kind of standard burner which will produce that result when it is burning gas at the rate of 5 cubic feet per hour. Thus the illuminating power meter will serve as a gauge instrument, showing the real value, from a consumers point of view, of the gas tested by it, and, at the same time, as a guide to the engineer, of what he may reasonably expect will be the number of candles which will figure in the report of the official gas examiner, who will make his tests with the parliamentary apparatus at the testing-station.

Those of our readers who possess Kirkham and Sugg's Lowe's jet photometers will doubtless appreciate at once the advantage of having an apparatus by which they can check the working of these instruments, and satisfy themselves whether they are in good working order without the trouble of sending them to be compared with any standard jet photometers. For with this new instrument the check test is threefold. Firstly, the amount of light given by the 3-inch flame can be verified by taking the average of a number of observations by the aid of the comparison photometer with fair parliamentary sperm candles; secondly, the indication of the illuminating power meter can be compared with those of the jet photometer; and thirdly, the test may be made with the aid of candles and the usual parliamentary standard burner on the comparison photometer. Having once satisfied himself of the accuracy of his instruments, the engineer will be able at any moment to ascertain what kind of gas he is making by a glance at the jet photometer, or in a two or three minutes consultation with the illuminating power meter; the working of any quality of coal can be accurately and rapidly checked, and the supply to the district kept uniform in quality from hour to hour.

It is probable that the new instrument will not be received with favour by the producing staff of a gas-work, excepting as an occasional check upon their Lowe's jet photometers. They have such confidence in the accuracy of these instruments, engendered by constant familiarity with them, which is in the highest degree flattering, and encourages the hope that when with the aid of the new instrument, the range of scale may be extended and verified with greater precision than has been hitherto possible, owing to the want of suitable standard burners for the richer gases, the number of those who consult them will be very largely increasing.

It may be fairly claimed for Lowe's jet photometers, that they have done more towards assisting engineers to satisfy the wants of the public, by supplying gas of regular illuminating power, than any other apparatus in use on gas-works, and it is hoped that the illuminating power meter will be found equally as efficient as a check test to the jet photometer, and a means of enabling the engineer to compare different samples of coal with each other, and ascertain the relative value of gas produced from them to the consumer.

It has been said of the jet photometer that it is an empirical test, and that although it is intelligible to those who understand it, it does not impress the mind of the consumer with the fact that the values given in the chart as being the illuminating power of gases, after the observed height of the flame under certain pressures, are reliable. The same cannot be said of the illuminating power meter. The standard light, equal to 16 sperm candles, from which its indications are deduced, is measurable by the eye and by comparison with other lights, and the quantity of gas which furnishes this standard is measured by the instrument, the highest value being accorded to the gas which affords this light with the smallest quantity.

[One of these instruments will be shown at the Exhibition of Scientific Apparatus, Kensington, and one has been sent to the forthcoming Exhibition in Philadelphia.]

Brighton Corporation Water-Works.—The accounts for the past year show that, after paying all expenses—including a considerable amount of interest for money borrowed for erecting new engines, constructing reservoirs, and other works connected with the pumping-station—there is a balance in hand of £1155 3s.

Droitwich Water and Sewerage Works.—The Corporation of Droitwich have resolved to ask the sanction of the Local Government Board to a loan for carrying out the work of water supply and sewerage in the borough, and Mr. Pritchard, C.E., of Warwick, has been appointed their engineer, to whom the work is entrusted.

ESTIMATION OF THE ILLUMINATING POWER AND PURITY OF COAL GAS.

By Mr. A. VERNON HARCOURT, M.A., F.R.S.

At the Meeting of the Chemical Section of the Society of Arts, London, on Friday Evening, March 31—Dr. ODLING, F.R.S., in the chair,

Mr. A. VERNON HARCOURT, M.A., F.R.S., Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees, read the following paper on "Some Methods of Estimating the Illuminating Power and Purity of Coal Gas":—

It is well known that coal gas which has been purified from sulphuretted hydrogen is not free from sulphur, but retains, chiefly in combination with carbon, a quantity of this element, varying from 10 to 40 grains in 100 cubic feet. It is commonly believed that the small quantities of sulphurous and sulphuric acid, produced by the burning of coal gas, distinguish it unfavourably from other illuminants, and hence there is a general wish among both the consumers and producers of gas to remove, as far as possible, the last traces of sulphur.

Sulphuretted hydrogen is one of the few substances for whose presence, even in very small quantity, we have a test which any one can apply, which is quick and conclusive. The existence of such a test has, no doubt, contributed greatly to the development of a system of purification, by which coal gas, at least in London, is always and absolutely freed from sulphuretted hydrogen. In his endeavour to purify gas from other sulphur compounds, the manufacturer has no test so handy as the strip of lead-paper to bear witness at once when the purifying material needs renewal. Increased facility of testing might lead, in this case also, to the discovery of better methods of purification, or to a better management of existing methods.

While endeavouring to turn to account, for the purification of gas, the effect of heat upon it, which converts the bisulphide of carbon in gas into sulphuretted hydrogen, it occurred to me that a test might be based on the same principle.

I have here a glass tube filled for 2 inches with a plug of platinum wire and foil. I am passing gas through it; but as the gas is pure from sulphuretted hydrogen, it does not affect the paper moistened with solution of acetate of lead upon which the gas is blowing. Now I heat the tube, and you will soon have evidence of the presence of sulphur in the gas.

This, however, is only a qualitative test, or, at most, the rate at which the paper darkens furnishes a very rough indication of the amount of sulphur in the gas. In the case of an impurity such as sulphuretted hydrogen, which is to be wholly removed, a qualitative test of this kind is all that is required. But, as no means are known of arresting completely the other compounds of sulphur, and all that can be done is to reduce their proportion as low as possible, a qualitative test is insufficient. What is required, as a guide in managing the process of purification, is a rapid quantitative test.

To fulfil this requirement, I propose to substitute for the lead-paper with the gas blowing upon it, a solution of lead, through which the gas shall pass in small bubbles. All the sulphuretted hydrogen in the portion of gas operated on is thus arrested; and, through the mixing of the liquid, an uniform colour is obtained, whose shade the eye can compare with that of a similar portion of a standard coloured liquid. If the passage of the gas is continued until the tint—which grows continually darker—matches that of the standard liquid, a definite and ascertainable quantity of lead sulphide must have been formed, containing a known quantity of sulphur and that derived from a known volume of gas. The larger the volume of gas that must be passed before this tint is attained, the smaller, in exact inverse ratio, is the proportion of bisulphide of carbon in the gas.

To prepare a lead solution which gives a clear tint, instead of becoming turbid when acted on by sulphuretted hydrogen, I dissolve litharge in caustic soda, and add a relatively large quantity of solution of sugar. For each testing, a little of the solution thus prepared is mixed with 20 or 30 times its volume of water.

For a standard of comparison, I have tried various colouring matters. Any red, yellow, and blue seem to give a brown. Cochineal, caramel, and indigo, rightly proportioned, matched the tint of the coloured lead solution very satisfactorily, and the appearance of the liquid did not change perceptibly from day to day; but, after some weeks, I found that my result had varied, and that the gradual fading of the standard colour was the cause. Since then I have used a mixture of the three sulphates of copper, cobalt, and iron, substances which are perfectly stable. To imitate a dark shade which the coloured lead solution has, probably owing to the sulphide of lead not being really dissolved, but rather suspended in a state of minute division, I add a trace of lamp-black to the standard liquid.

Unfortunately, the coloured lead solution and the standard look differently by daylight and by gaslight, and, through the change of light, they become extremely different one from another. I have, therefore, prepared another standard for use by gaslight, and it happens conveniently that a mixture of the sulphates of cobalt and copper serves the purpose.

The volume of gas which has been operated upon is known with sufficient accuracy, by reading off the volume of water which has run from the aspirator into the measuring vessel placed beneath. The standard has been made such that, to impart the same tint to the same volume of lead solution, there is required 0·0025 grain of sulphur. From this datum, and the capacity of the measuring cylinder, I have calculated a table, giving the number of grains of sulphur in 100 feet of gas corresponding to each graduation.

The apparatus, in the form in which I have it here, is probably familiar to some who are present, as I brought it before the meeting of the British Association of Gas Managers at Leeds last summer, and my account of it was published in the JOURNAL OF GAS LIGHTING.* But quite recently a suggestion made to me by Mr. Wills has led to an improvement in the apparatus, which may, I hope, help to justify me in giving this further account of it.

Mr. Wills suggested to me to use platinum as the heated material over which the gas should pass, he having observed that the development of sulphuretted hydrogen occurred at a lower temperature, when the gas was in contact with platinum, than when it is heated otherwise.

Such an action of platinum upon mixtures of gases is familiar to chemists by many examples, and I can only plead in defence of the comparatively bulky and inconvenient form which my test has assumed hitherto, that I designed it, in the first place, not for laboratory use, but to illustrate a chemical fact, which I hoped to turn to account on a large scale for the purification of gas. Those who have used it must, I think, have convinced themselves that, when gas is passed through a layer of heated pebbles, the sulphur contained in it, with the exception of eight or nine grains in 100 cubic feet, is converted into sulphuretted hydrogen, and can, therefore, be easily removed.

If any others have had this test in operation, as I have, continuously for several months, they will also have convinced themselves that the action of the heated surface upon the gas may be continued for an indefinite time, if the temperature is not allowed to rise too high, and if, at intervals of one or two months, air is drawn through the apparatus.

Experimenting with this larger object in view, I made trial only of common materials which it was practicable to use on a large scale. Perhaps it is impossible that so costly a metal as platinum should be used in gas manufacture, especially where the object in view is only a slight improvement in the quality of the article manufactured. But it is possible to employ costly materials for common uses where, as in the use of gold on paper-hangings, a little goes a long way. Substances which can be dissolved may be spread over an indefinitely large surface, by wetting the surface with their solution. Mr. Deacon has thus applied copper to the manufacture of chlorine. Whether or not the action of heated platinum on gas may hereafter find any more extended application, it serves exceedingly well the purpose of this test. It may be used by leading gas through either a piece of glass tube packed with platinum wire, or a bulb filled with pumice which has been steeped in chloride of platinum and ignited.

I have now, in the second place, to direct your attention to certain methods of estimating the illuminating power of coal gas. Such methods divide themselves into two kinds; those in which the amount of light obtainable from a given volume of gas is, by some means, directly estimated, and those in which it is inferred from some other property of the gas.

Of the latter, which I may call indirect methods, one of the best, but the most troublesome, is the complete analysis of the gas. This demands a special and somewhat complicated and fragile apparatus, and considerable manipulative skill on the part of the operator. Improvements in the methods of gas analysis have considerably reduced the length of the operation, but it can hardly occupy less than three or four hours.

Some information, but of rather uncertain value, is to be derived from the determination of the specific gravity of the sample of gas.

Absorption by bromine of the olefines, to which chiefly the illuminating power of gas is due, is an operation which can be easily and quickly performed, and which should give trustworthy, though not very exact, indications of the relative value of different samples of coal gas.

The simplest and most trustworthy of the indirect methods are those which depend upon the relation between the quality of different samples of gas burning under the same conditions, and the size of the flame which they produce. The size of the flame is most easily observed by giving it the form of a long narrow column, as in Lowe's jet photometer. The samples of gas to be compared may be burnt when issuing either at the same pressures or at the same rate. Or else the length of flame may be kept constant and the required pressures or rates of consumption compared. The last named modes of operation are those employed in Messrs. Kirkham and Sugg's form of the jet photometer, and in the "duration" test. Still another mode of making the same comparison has recently been proposed by Mr. Sugg, who has been kind enough to lend me his "illuminating power meter" to show here this evening. In this instrument the gas is set to burn from an Argand burner with a flame 3 inches in height. It can be made either to pass through the meter or not; and in the upper part of the meter-case is a minute clock. The index of the meter having been stopped at the top of the scale, gas is sent through the meter for one minute by the clock, and then turned off again, the flame being constantly maintained at the height of 3 inches. According as the gas is richer or poorer, the index of the meter will have travelled a less or greater distance; and the dial-plate is so graduated and numbered that from the place at which the index has stopped, the illuminating power of the gas may be read off.

Direct observations of the illuminating power of different samples of gas have hitherto been made by a judgment of the eye, comparing under conditions favourable to exact observation the relative brightness of the flame produced by the sample of gas and of a standard light.

Within the last year, however, two substitutes for the direct judgment of the eye have been suggested, founded upon the observation of two physical properties of light. The facts which have been observed in both cases are of transcendent scientific interest; but I must here confine myself to the proposed practical applications of them to photometry.

The element selenium is a substance so incapable of conducting electricity, that it has been used as an insulator in telegraphy. Three years ago Mr. Willoughby Smith observed that its power of insulation was impaired by exposure to sunlight. Since then this effect of light has been examined by Dr. Werner Siemens and Professor Adams.

Unfortunately the effect of light upon the electric conductivity of selenium varies according to the temperature to which the selenium has been exposed, and the mode of cooling; moreover, the effect of light gradually diminishes, and after prolonged exposure the selenium needs to rest in darkness for a length of time before its sensibility is fully restored. The most comparable results are obtained by observing the maximum effect produced when a piece of selenium, inserted in a galvanic circuit, comprising a battery and a galvanometer, is exposed to various sources of light for a few moments. Professor Adams employs a piece of crystalline selenium, which is exposed to different sources of light successively, for ten seconds, and observes the maximum deflection of the needle of the galvanometer. Dr. Siemens arranges the ends of two fine wires in a spiral or zigzag form, so that within a small space each may be close to the other, without touching, for a considerable length. By covering the interlacing spirals or zigzags with a drop of molten selenium, pressed into a thin sheet between two leaves of talc, the wires are connected throughout this length by a surface of selenium.

The sensitiveness of the selenium element thus prepared is admirably shown by an apparatus designed by Dr. C. W. Siemens, which he has kindly lent me for this evening. In it the selenium element plays the part of the retina of the eye; in front of it is a lens to bring the rays of light to a focus upon it, and beyond this, a pair of metal eyelids closing by a spring, which preserve the selenium retina from the fatigue it would experience if constantly exposed to light.

Dr. Werner Siemens compares the light from two sources by so adjusting their distance from the selenium disc that, when it is exposed to each in rapid succession, the deflection of the galvanometer remains unchanged.

Selenium thus employed is said to be unaffected by the obscure heat rays, but to be affected by the red end of the spectrum in a greater degree than corresponds to the impression produced by that part of the spectrum upon the human eye. This defect may be remediable, as Dr. Siemens suggests, by interposing a sheet of glass with a green tinge. But a difficulty which must be overcome before any physical effect of light is accepted as a substitute for its impression upon the eye, is that of proving an exact correspondence between the physical and optical effects.

This vacuous globe containing the finely poised discs, which revolve rapidly when brought near a lamp, has already become familiar. It is called by its inventor, who is also the discoverer of the repulsive force induced by radiant heat and light, a radiometer. Mr. Crookes has ascertained that the difference between the repulsive force induced upon the black and white surfaces of the discs, respectively, as measured by the rate of rotation, varies directly with the amount of light or radiant force falling upon them. Two candles, for example, at any given distance, produce twice the rate of rotation which is due to one, and the effect upon the instrument of a given light varies inversely as the square of its distance.

But in this case, much more than as affecting the electric conductivity of selenium, radiant light needs to be separated from radiant heat, before the motion due to its impact can be employed as a measure of illuminating power. Through the kindness of Mr. Crookes, I am able to show you the instrument which he has devised for comparing the amounts of light, separated from the rays of greater and less refrangibility, issuing from two or more sources. A pith beam, suspended horizontally in a vacuous globe by a single fibre of silk, is blackened on both sides for half its length. When light falls upon one side of this beam, the blackened half recedes; and, in the absence of other forces, the beam would set itself with its white end pointing towards the light. To the centre of the beam are attached, in a transverse direction, a small magnet and mirror. The former serves, when a magnet is placed

* See JOURNAL, No. 639, page 226, and No. 640, page 265.

beneath the apparatus, to make the beam assume a particular position, from which it can be displaced more or less, by the incidence of a stronger or weaker light on one side, but to which it returns when no longer solicited by other forces. The latter serves, by reflecting a pencil of light on to a scale some distance off, to render evident a small displacement of the beam. If two sources of light are placed on each side of the beam, such and at such distances that no displacement occurs, the amounts of radiant force emanating from each, and acting on the two sides of the beam, are equal. In order that the forces thus compared may be due to radiant light only, two glass cells, with parallel sides, are filled with solutions of sulphate of quinine and of alum, to cut off the invisible rays at each end of the spectrum.

Errors of observation, in judging of the relative brightness of the two sides of a partially translucent disc, may hereafter be got rid of by the adoption of one or other of the methods which I have attempted to describe. But two problems remain, a satisfactory solution of each of which is more necessary to the establishment of a trustworthy system of photometry, than the substitution for the disc of some more absolute criterion of illuminating power.

The first problem is, what standard shall be used for the measurement of artificial light; the second, what burner shall be used in testing the illuminating power of coal gas.

The present unit, as defined by Act of Parliament, is a sperm candle of six to the pound, burning 120 grains an hour. This is convenient as an unit, since the light given by different lamps and gas-burners may be described, without the use of high numbers or of decimals, as a light of 10, or 15, or 20 candles. But without further definition, it is by no means satisfactory as a standard, since the light which a candle gives depends not only upon the material of which it is made, and the rate at which it burns, but also upon the construction of the wick. Some difference of opinion exists among those experienced in candle photometry as to the extent of fluctuation to which the results thus obtained are liable. According to my own experience, sets of observations made one after the other with the same sample of gas, and with candles from the same packet, often agree very closely, and seldom differ to the extent of one candle. Occasionally, however, without any apparent cause, the results are more divergent; and I have found a considerable difference in the results and in the degree of uniformity with different packets of candles obtained from different dealers. What the burner is to gas, its wick is to a candle; and just as the definition of the illuminating power of gas has been unsettled by improvements in the burner used for testing, so it may also be altered by the application of similar attention and skill, on the part of the candle maker, to the conditions under which the maximum illuminating power can be developed from the combustion of 120 grains of sperm per hour.

If it be possible, as I hope to show that it is, to furnish a more constant standard of comparison for artificial lights than the sperm candle, the term "candle" might still be retained as the name of an unit otherwise defined, just as "foot" has come to be the name of an exact measure.

In Paris, the photometric standard is the Carcel lamp, burning colza oil at a given rate. Some years ago Mr. Keates proposed the use of a lamp burning sperm oil, and I understand that such a lamp has recently been constructed on an improved principle by him and Mr. Sugg. I have not personally made trial of any of these lamps, but probably they give a light more constant, and more comparable with that of a gas flame, than is the light given by a pair of candles. At the same time, the very fact that an improved form of lamp has recently been constructed—if, as I believe, the improvement relates not only to the constancy, but to the illuminating power of the lamp—suggests the likelihood that one standard lamp might differ in some degree from another, and that further improvements might gradually creep in. With a lamp, as with a candle, the wick is a most important element, and one which it is exceedingly hard to fix or define.

It was to meet the uncertainty as to the construction of the wick—and also that as to the composition or purity of the liquid fuel—that Mr. Crookes devised this little lamp which he has kindly lent me. Its wick consists of a certain number of platinum wires of a certain size. The liquid which burns is a mixture of two pure substances, alcohol and benzol. The light is said to be much more constant than that of a candle; but the flame in its present form is too small to be conveniently compared with that obtained from gas burning at the rate of five cubic feet an hour.

At present, I think it must be admitted that the problem of devising a satisfactory photometric standard, which can easily be obtained at different places, and is easily applied, and is such that when prepared with due care, absolute confidence may be placed in its uniformity, has still to be solved.

Upon this problem I have been working at intervals during the last two or three years, and though I am still occupied with the work, and have not yet completed it, I may be permitted to lay before you the results at which I have arrived, and to show what would be the operations required for testing the illuminating power of coal gas under the system which I propose.

In place of candles or lamps, I propose to use a standard gas. As no single gas exists which is suitable, a mixture of gases must be employed; and that which I believe to be most suitable is a mixture of hydrogen with pentane or with pentane and hexane. The two substances last named constitute the most volatile portion of American petroleum. Under a pressure of one atmosphere pentane is a liquid at temperatures below 30° C., and hexane at temperatures below 68° C.; but under a pressure of one-tenth of an atmosphere, and probably under somewhat greater pressures, both these substances are gases at the ordinary temperature. To reduce the pressure upon them, and also to reduce their illuminating power to that of ordinary coal gas, they must be mixed with another gas. I have tried both air and hydrogen for this purpose, and I prefer hydrogen for the following reasons:—A smaller quantity of petroleum, in about the proportion of two to three, is needed with hydrogen than with air for the same illuminating power, and thus the petroleum gas is under a less pressure, and further from its point of condensation. The gas prepared with hydrogen has about the same specific gravity as coal gas, and therefore, presumably, the same burner is suitable for both, whereas the gas prepared with air is, of course, heavier than air. In preparing the standard gas with air, a meter must be used to measure its volume, and corrections applied for the variations of barometer and thermometer, whereas by acting on an excess of zinc with a known weight of sulphuric acid, a quantity of hydrogen is obtained, which is accurately known without the need of either measurement or correction.

The following, according to Cahours, are the constituents of petroleum boiling below 100° Cent.:—

Pentane, C_5H_{12}, sp. gr. at 17° Cent., 0·628, boiling point, 30°.
Hexane, C_6H_{14}, sp. gr. at 16° Cent., 0·669, boiling point, 68°.
Heptane, C_7H_{16}, sp. gr. at 16° Cent., 0·6995, boiling point, 92° to 94°.

Starting with the lightest petroleum which is obtainable commercially, I have rectified it with the following results. The composition of the samples is calculated on the supposition, which is probably nearly correct, that by rectification below 65° heptane may be excluded.

Petroleum rectified below 45°				specific gravity at 15°,	0·635
"	"	45°—55°	"	"	0·647
"	"	55°—65°	"	"	0·664
"	"	below 65°	"	"	0·646

Composition of Samples.	Below 45°.	45°—55°.	55°—65°.	Below 65°.
Pentane . . .	82·9 ..	53·7 ..	12·2 ..	56·1
Hexane . . .	17·1 ..	46·3 ..	87·8 ..	43·9

The proportion of hydrogen, which must be added to the hydrocarbons to produce gas of constant illuminating power will vary slightly according to the composition, or specific gravity, of the sample of petroleum employed. It is on this point chiefly—a point of capital importance—that I need still to make further experiments. I have worked chiefly with the sample whose specific gravity is 0·646.

To prepare standard gas I employ the following apparatus:—A flask of from 3 to 4 litres capacity, into the mouth of which a thistle-funnel and elbow-tube pass through a plug of india-rubber; a wash-bottle of about a litre capacity; a gasholder capable of containing 7 or 8 cubic feet; one or more graduated vessels for measuring out the required quantity of dilute sulphuric acid; a Winchester quart, fitted with pinchcock and inlet-tube for air, to hold the measured quantity of acid and deliver it by degrees into the generating flask; a pipette of 70 or 100 cubic centimeters capacity, to measure the required dose of petroleum, and deliver it into the wash-bottle.

The operation of preparing standard gas is as follows:—The flask is filled one-third with granulated zinc, and connected with the wash-bottle, two-thirds of which is filled with water. About 100 cubic centimeters of dilute acid is first poured upon the zinc, which generates sufficient hydrogen to sweep out air from the flask. When the evolution of hydrogen has ceased, which requires about half an hour, the wash-bottle is opened, and the pipetteful of petroleum discharged into it, after which the wash-bottle is at once closed and connected with the gasholder. The Winchester quart, holding the measured volume of dilute acid, is supported in an inverted position, and its pinchcock is so adjusted that the acid may flow in a rapid succession of drops into the generating flask. Hydrogen passes in a rapid stream through the water in the wash-bottle and through the layer of petroleum, which floats upon the surface of the water, and the mixed gases pass on into the holder. From this point the operation needs no further attention. When all the acid has run in, the evolution of hydrogen gradually diminishes, and almost ceases by the time that the liquid, heated by the action, has become cold. The gasholder then contains the whole of the petroleum which was taken, and a quantity of hydrogen which is also exactly known, since the sulphuric acid has saturated itself with zinc, and consequently has yielded 1-49th its weight of hydrogen.

The water in the wash-bottle serves to prevent any acid spray passing to the holder, to provide a level floor for the evaporation of the petroleum, and to furnish the heat which the petroleum needs to pass from the liquid to the gaseous state. The absorption of heat, as the petroleum volatilizes, reduces the temperature of the contents of the wash-bottle considerably below that of the surrounding air. Consequently, the standard gas is formed at a temperature below that to which it is afterwards subjected. In spite of this reduction of temperature, the whole of the petroleum has generally disappeared when two-thirds of the hydrogen has passed over. Consequently, the standard gas is formed under a pressure exceeding, by at least one-fourth, that to which it is afterwards subjected. It is, therefore, a permanent gas under any conditions to which it is likely to be exposed.

I have here two similar tubes, standing vertically in a vessel of water, which have been filled to the same level, one with air, the other with standard gas. When ice is placed round them, so that their temperature falls to 0°, the contraction is the same in both cases, showing that the standard gas behaves like a permanent gas, and that no liquid petroleum is condensed out of it.

The dilute sulphuric acid which I have employed has the specific gravity 1·217, and contains 0·352 grams of pure sulphuric acid in 1 cubic centimeter. It may be made, approximately, by mixing 26·5 volumes of oil of vitriol with 100 volumes of water. The strength of the dilute acid is unimportant, provided it be exactly known, and provided it is not such that sulphate of zinc crystallizes out, and hinders the action of the acid.

It will be seen that the adjustment of the illuminating power of the gas is thus practically brought, with an acid of known strength, and a particular sample of petroleum, to a question of rightly proportioning the volume of acid to the volume of petroleum. The following are some of the results I have obtained with acid of the above-mentioned strength and petroleum distilled below 65°, and having the specific gravity 0·646. The numbers given under the head of illuminating power are, in most cases, the mean of four or five different sets of observations made with different samples of standard gas, prepared according to the same recipe:—

Volume of Dilute Acid. Sp. Gr., 1·217.	Weight of Pure Sulphuric Acid.	Weight of Hydrogen.	Weight of Petroleum.	Ratio of Petroleum to Hydrogen by Weight.	Illuminating Power.
c.c.	Grams.	Grams.	Grams.		Candles.
1680	593	12·07	45·22	3·75	14·5
1640	579	11·78	"	3·84	15·2
1615	570	11·6	"	3·9	15·9
1610	568	11·57	"	3·91	15·97
1605	567	11·53	"	3·92	16·1
1580	558	11·35	"	3·98	16·6

Hence it appears that a mixture of one part by weight of hydrogen and 3·91 parts by weight of light petroleum, form a gas of 16-candle illuminating power. I propose the use of this gas as a photometric standard. It consists of 90·9 volumes of hydrogen and 9·1 volumes of gaseous petroleum. It contains in 1 litre 0·265 gram of carbon. It is easily prepared of constant composition, and in any required quantity.

I have still to determine what modification needs to be made in the proportion of hydrogen—that is, of dilute acid employed—with samples of petroleum of different specific gravities. Probably it will be possible to connect, by a simple formula, the specific gravity of any sample of light petroleum with the proportion of sulphuric acid which must be used with that sample, in order to furnish 16-candle standard gas.

It remains for me to describe briefly the form of photometer which Mr. F. W. Hartley has arranged for me, in which to compare the sample of gas to be tested with the standard gas. It corresponds to the ordinary open photometer, with a 60-inch bar, except in the following particulars.

Both ends are furnished with similar "London" Argand burners, with the usual appliances for measuring and regulating the current of gas, all in duplicate. By a suitable arrangement of cocks, either sample of gas may be sent into either meter, and thus to either burner. The centre line of the bar is numbered 16, and two scales having this line in common are drawn out, one beneath the other, so that the position of the pointer which travels with the disc can be read upon each.

One scale is to be used when the standard gas is burning on the right, and indicates the value in candles of the gas compared with it; the second scale is the reversed image of the first (corresponding to it as the image of an object in a mirror does to the object), and is to be used when the standard gas is burning on the left. When a reading has been made on one scale, the samples of gas are to be reversed, and a second reading made on the other scale. The geometric mean of these two readings is the true illuminating power of the sample of gas tested, depending for its accuracy upon the quality of the standard gas, but independent of variations of temperature and pressure, and of all inequalities in burners, meters, or disc.

Comparing thus directly one gas with another, it is likely that the nature of the burners employed will make little, if any, difference—at least, where the gas tested has nearly the same illuminating power as the standard gas. If so, an indirect but important advantage that would accrue from the adoption of this method is, that a question which has been hotly debated, as to what kind

of burners ought to be employed in testing the illuminating power of gas, would disappear altogether.

The CHAIRMAN said it was now his duty to call upon the gentlemen present—and he saw many before him who were largely interested in gas matters—to raise any point that might have occurred to them in reference to the paper Mr. Harcourt had been good enough to read. But before inviting discussion, he would like to say, on his own behalf, how very much he sympathized with Mr. Harcourt in the tribute of respect he had paid to the memory of the late Dr. Letheby, who was one of the pioneers of this branch of applied chemistry, and the very first by whom any continuous series of gas examinations were made on account of any public body. Very much, at any rate, of the large development of the subject was to be traced to his early exertions. Dr. Letheby was known familiarly to many present, and he (the chairman) having been associated with their departed friend in many ways could say with confidence, that no interest entrusted to him was ever neglected, and that he certainly acted in every way with the utmost loyalty to all those who were connected with him. Referring now to the paper which had been read, he remarked that there were many interesting points raised by Mr. Harcourt. He would particularly call attention to the utility of the sulphur test, now brought before the meeting, which could be used to determine the amount of sulphur compounds in gas, by an experiment lasting for about 20 minutes. Then that very interesting point—the substitution of the artificial eye—the artificial mode of measuring light, devised by Dr. Siemens and Professor Adams on the one hand, and by Professor Crookes on the other. And this was followed by the suggestions with regard to the defects in the standards of illuminating power as ordinarily employed, more particularly in reference to candles; and, lastly, the advantages which must necessarily arise from the employment of standard gas, the particular mode of producing that standard, and the alteration of the one burner for the other, as so ingeniously suggested by Mr. Harcourt.

Mr. G. LIVESEY said, having been called upon by the chairman to address the meeting, he did not know that he could do better than by stating, in the first place, that the sulphur-test apparatus devised by Mr. Harcourt had been in use at the South Metropolitan Gas-Works for the last six or seven months, and that he had found it a very useful test indeed. He did not say that it was so exact as the ordinary test—he did not believe Mr. Harcourt ever pretended it would be—but he had found it exceedingly useful in giving an approximate notion of the amount of sulphur in the gas, and it was a test that could be taken in a few minutes. He had found that Mr. Harcourt's tests generally gave rather higher results than the official tests, or the tests made by the company. For instance, taking the last ten days, the results were these:—By Mr. Harcourt's tests the average had been 18 grains, the highest being 20 and the lowest 17. By the official tests the average had been 16 grains, the highest being 17 and the lowest 15. These 10 days were, perhaps, exceptionally good averages of the tests, as on previous occasions there had been somewhat greater variations. Invariably, however, the official test had been a few grains below that obtained on Mr. Harcourt's principle. It would, therefore, give them great assistance in arriving at an approximate idea of the state of the purifier. He (Mr. Livesey) could not, however, refer to the sulphur question without saying something further, and that was that, while scientific men had by their investigations discovered these sulphur compounds, and had built up a theory as to their injurious effects, he had himself never yet been able to discover that they had been able to produce proof of any such injurious results. He believed that no one now would contend that the small quantity of sulphur to be found in coal gas, after purification by oxide of iron, had the slightest injurious or other effect on the health of human beings. The chairman himself had demonstrated, and it had been hitherto unanswerable, that, in the very worst conceivable case, the proportion of sulphurous acid in the air of a gas-lighted room would not be more than one part in 500,000 parts—a fact which, as the chairman had stated on one occasion in the hall in which they were now assembled, reduced the matter to an absurdity. Their late friend Dr. Letheby once made the remark to him, as showing the estimation in which local authorities regarded the subject, that although, when private companies applied for an Act of Parliament, they were always very anxious to have a sulphur-test clause inserted, yet when they came forward themselves for power to purchase and carry on works, they were by no means anxious to be tied to a high standard of purity in this respect. It was clear, therefore, that the public authorities of the principal towns in the kingdom did not regard the sulphur question as of any importance. And it must be remembered that, at the best, the use of lime did not entirely remove these sulphur compounds, and that in towns like London, without lime at all, the sulphur compounds could be limited to 30 grains, although he had found 40 to be the maximum—generally running to 33 or 34. But now there were certain restrictions put upon the companies, and they were called upon to reduce this 33 or 34 to something below 25 in the winter, and 20 in the summer—a reduction which it was not really worth the trouble to effect. If lime would take the sulphur compounds out entirely—although he did not believe they were any injury at all—it might, perhaps, be worth while to endure the miseries produced by its employment. As it was, it was often a serious injury to the poor fellows, who sometimes lost their sight altogether when changing lime purifiers; it was also a great nuisance in the neighbourhood in which it was used, and after all was of no public benefit. Turning to other matters in Mr. Harcourt's paper, he remarked that he was glad to hear the writer say the question of illuminating power was of far greater importance. Now he (Mr. Livesey) held this to be an essential matter, and it was one upon which gas engineers and managers required assistance. He was afraid that the public did not regard the testing of the illuminating power of gas with much respect. The burner employed for the purpose had been sometimes described as the "juggle burner." Other disrespectful terms had also been applied to it. Unfortunately the testing could not, at present, be exactly accomplished, and he, therefore, felt that gas managers were much indebted to those scientific men who had devoted their time and thought to discover a more certain means of effecting it. He was afraid, however, that the public would not place much reliance upon those very delicate chemical tests mentioned, such as the artificial eye. He thought probably that which would be most satisfactory would be Mr. Sugg's standard flame, or perhaps Mr. Harcourt's standard gas—*i.e.*, testing one gas with another. As to the question raised about the burner, in the year 1868 it was said the companies were to have the benefit of any improvement introduced in the way of burners. For his own part, however, he did not think this would be fair to the public. If, for example, he were in the habit of burning oil, and, by some improvement in the construction of lamps, it was found that he could obtain 10 or 20 per cent. more light therefrom, he certainly should feel much discontent if the oilman insisted on his right to supply oil of a proportionately lower quality. In his opinion, the standard of the illuminating power of gas ought to be fixed as a matter of justice, and if afterwards improvements were made in burners, the public should have the benefit of those improvements. He felt that they were much indebted to Mr. Harcourt for the painstaking manner in which he had gone into the gas question; and having had some little experience of that gentleman, in making experiments upon a working scale, he could assert that Mr. Harcourt did not simply give his orders, and leave to other people the trouble of carrying them out, but he attended at the works five or six hours a day, and took part in carrying them out himself. Mr. Harcourt showed that he was thoroughly in earnest, and it was a pleasure to work with him.

The CHAIRMAN said he did not like to interrupt Mr. Livesey, but he thought he ought now to say that, in his opinion, there was sufficient intellectual food in the paper for one evening, without entering upon the question of public policy.

Mr. TREWBY, being invited to offer a few observations, said he was not sufficiently conversant with the tests mentioned to say anything about them. He felt that he and others were much obliged to Mr. Harcourt for the labour bestowed by him upon the improvement of the means of testing the illuminating power of gas. Any one who had had experience in the matter was fully aware of the great discrepancies which arose from the use of candles, so that any means that could be devised for getting rid of this source of error would be a great boon both to the gas companies and to the public.

Mr. C. WOODALL said he should like to say one word in confirmation of what Mr. Livesey had stated as to the great value of the sulphur test exhibited that evening by Mr. Harcourt. And, at the same time, without entering further into the subject, he would remark that he cordially endorsed the observations made by Mr. Livesey, as to the exaggerated importance attached to the purification of gas from the last trace of sulphur. The official test for sulphur meant a test extending over 24 hours, and within that time the whole condition of affairs at the gas-works might undergo a total and complete change. But, by this apparatus, the manager was able from hour to hour to watch the operations going on in the purifiers. He could hardly feel much confidence (and he said it with the utmost deference) in the proposition to test his gas by means of another gas prepared in the way described. The attempts made hitherto to make gas by infusing hydrocarbons into hydrogen, had not been successful in producing a gas likely to maintain its quality for a length of time. The preparation of such a gas day by day would be very troublesome, and if it was not permanent, would be liable to lead into considerable error. Mr. Harcourt believed the gas would be permanent, and his opinion was entitled to great weight on the point; but it would be well to have the matter further investigated. As to the other appliances mentioned, he (Mr. Woodall) had looked, for the last month or two, with the greatest interest and expectation to the possible results from Mr. Crookes's discovery. He certainly thought there was a great probability that a photometer might be constructed on the principle of the radiometer, which would be satisfactory to gas manufacturers and to consumers. The advantage it would have was similar to that of Mr. Sugg's illuminating power meter, without the difficulty pointed out by Mr. Harcourt in the latter, of determining the exact height of the flame. It would save them from the two elements of error most conspicuous in the present system—the variation in the observations of different people's eyes, and the variations in the quality of the candles employed. About a month before, he had experimented upon a candle sent from Russia, which Mr. Wills pronounced to be pure sperm, and found that it gave from a consumption of 105 grains, the same light as could be obtained from the consumption of 120 grains of an ordinary standard sperm candle. If such candles were introduced into the testing offices in London, they would be as injurious in their effect against the companies as the new burner had been advantageous.

Mr. WILLS said Mr. Harcourt having mentioned his name, he might say that his suggestion to Mr. Harcourt to substitute platinum for the pebbles in the sulphur test was made in consequence of a few experiments he had made with Mr. Harcourt's first apparatus, which he found liable to crack with heat, and get out of order. He naturally thought of platinum, on the account of its well-known catalytic action in bringing about the combination, and, in some cases, the decomposition of gases. It answered admirably, the desired result being obtained at a much lower temperature. He would further suggest that an air-bath should be substituted for the gas flame, by which a constant temperature would be maintained; 300° was quite high enough to bring about the decomposition of the bisulphide of carbon in the gas, and convert it into sulphuretted hydrogen; and if the temperature could be kept constant, and the gas passed at a fixed rate, very accurate results might be obtained. From some little experience in gas testing, he could endorse all that had been said about the varying character of candles; and some experiments he had made went to show that, when the candles were burning less than 120 grains per hour, they gave proportionately more light than when burning at a greater rate. Thus, he found that testing gas by two candles which burned a little over 41 grains in ten minutes, and by a pair which burned only 38 grains, there was a difference of more than one candle in the quality of the gas. Thus it might happen that if a gas company were supplying gas very near the minimum quality, and it were tested by a pair of candles burning at less than the proper rate, it would be returned as below the standard; whereas, if it were tested with a pair of candles burning above the normal amount, it would be returned as over the standard. Testing the candle received from Russia against an ordinary gas-testing candle, he found that, if the two were burning about the same amount of sperm in the same time, the Russian candle gave more light proportionately; but if the common candle were burning from 1 to 1½ grains less per ten minutes, the difference was imperceptible. It had occurred to him, and he had previously suggested to Mr. Harcourt, that the illuminating power of gas might be estimated by determining the amount of carbon which it contained. The colourless flame of an ordinary Bunsen burner could be converted into a luminous flame by shutting off the supply of air; and it struck him that, by determining the amount of air required to obtain a non-luminous flame with a certain volume of gas, you would obtain a true measure of its illuminating power, and that if an apparatus could be constructed so as to give this with accuracy, a very fair standard would be obtained.

Mr. FEWTRELL said he should like to make a few observations in reference to the sulphur test. After the remarks made by Mr. Wills about a temperature of 300°, it seemed a little extraordinary that the name of the Rev. W. Bowditch had not been mentioned in connexion with the decomposition of bisulphide of carbon at that temperature, because it came to very much the same thing, whether pebbles or clay were employed in the process. Having been precluded by the chairman from making any observations on questions of public policy, he was unable to tell a story or two which would have furnished a reply to the statements made by Mr. Livesey. He would, therefore, only make one remark in reference to the composition of the standard gas, proposed by Mr. Harcourt. He did not doubt at all that Mr. Harcourt was able to obtain a standard of illuminating power, because, as he stated, he obtained a perfectly uncondensable gas; but he (Mr. Fewtrell) would doubt the value of a comparative test of this kind, unless pure olefiant gas was employed. He did not believe in the mixtures of petroleum and hydrogen, and he did not see how a gas of constant quality was to be maintained. Of course, if pure olefiant gas was employed, there was a standard that could be relied upon; but such a process would be very expensive. Meantime, and until the advantages of the method described were more clearly demonstrated, he would stick to candles, believing they could not be surpassed for regularity. He had experimented with a large number of candles, obtained from all the manufacturers in London, and he had never found so great a difference as had been spoken of by Mr. Wills. Indeed, considering all things, there had been a remarkable consistency in them; and it was a curious point in reference to Mr. Crookes's communication to the Royal Society, that, in experimenting with his radiometer, he found he obtained exactly double the effect produced with two candles that was produced by one, which clearly proved that candles were more to be relied upon than some were disposed to think. He (Mr. Fewtrell) thought the thanks of the society were eminently due to Mr. Harcourt for the paper just read; and he desired to express an opinion that Mr. Harcourt's sulphur test was an admirably practical and convenient one for gas managers.

Mr. HARTLEY said he had listened with the greatest imaginable interest to the paper, and felt, in common with other members present, that the society was under a debt of gratitude to Mr. Harcourt for the ability and earnestness

with which he had addressed himself to the study of subjects in which gas managers were so largely concerned. That serious injury had ever arisen from the presence of sulphur in the gas supplied to the public, he did not admit; but it could not be lost sight of that there was a demand, on the part of the public, that gas should be as free as possible from sulphur. Every endeavour, therefore, on the part of scientific men to furnish practical men with the means, in the first place, of determining the amount of sulphur in gas, and, secondly, with the means of removing it, was a matter for which they ought to be grateful. Although he had not had an opportunity of using Mr. Harcourt's sulphur-test, he had seen it used, and could testify that it was a very valuable instrument for the gas manufacturer. As to tests for illuminating power, he confessed that he was an old candle-user, and he had failed to find such enormous discrepancies as some operators had stated, and for this reason —that he would not allow them to occur; for, if he found candles burning indifferently, he would reject them and select others. He had, on many occasions, when testing gas in the provinces, made an experiment at the town-hall with a photometer, and then gone down to the gas-works, a mile away; and, with the same or other candles, succeeded in getting the same results. Some years ago he, at the request of Mr. Thorman, made some experiments at West Ham, to determine whether any loss of illuminating power had occurred in the gas after travelling four or five miles. The result of his tests practically showed that, whilst there was little or no loss at that distance in the illuminating power, the candle standard could be depended upon. Coming now to a very important part of the paper just read—viz., the question of a standard gas—he remarked that, granting such a gas could be made, it would undoubtedly have advantages; but a difficulty presented itself to his mind. He had had much experience in the use of petroleum. He might state that he had found that with water gas—compounded of hydrogen, carbonic oxide, and carbonic acid—the upholding power of light petroleum was very great, and that it might be sent a great distance without loss of illuminating power. He had sent such gas through a mile of pipe laid in an open field, and exposed to a temperature of 38°. He had, therefore, great faith in light petroleum for rendering gas luminous. But it occurred to him that, owing to a change of barometric pressure, some deposit might take place in the holder in which the gas was stored; and though, perhaps, infinitesimal at the first, it might be cumulative. It might then happen that some portion of the deposit thrown down might again be given off, and so make the gas more luminous at one time than another. He did not presume to suggest that Mr. Harcourt had carried out his experiments so imperfectly as not to have arrived at a satisfactory conclusion on this point, but it would be well that they should be clearly stated.

Mr. METHVEN said he should like to ask one question. He understood from Mr. Harcourt that the permanent standard gas was to be manufactured in the operating-room. If so, it must possess a higher temperature than the gas to be operated upon, which had travelled some distance in the mains. What provision had Mr. Harcourt made to meet the difference of temperature, which would naturally affect the results?

Mr. HARCOURT then rose to reply. He said with reference to the remarks of Mr. Livesey, he must, of course, bow to the mandate of the chairman, and not enter upon the larger question thus raised. At the same time he had to thank Mr. Livesey for the obervations he had made as to the way in which they had worked together. Mr. Woodall raised a point as to the difficulty of preparing the standard gas. He (Mr. Harcourt) did not apprehend any difficulty in the matter, and he hoped to enable those who were present to form an idea of the facility of carrying out his method, by making the preparation during the time the discussion was going on. He had an arrangement by which the sulphuric acid supplied itself to the hydrogen bottle, so that from the moment when the tap was turned, and sulphuric acid began to flow into the bottle containing the zinc, nothing further needed to be done until the gas was wanted for use. If the process ever came into use, he would propose that the gas examiner should be furnished with two small holders, and that shortly before making the testings he should charge the bottle with a certain quantity of standard acid, put in a measured quantity of petroleum, open the cock, and leave it till next day. Whether the process furnished an exact result or not, he did not think there could be any difficulty in it. The distinction between the object aimed at in this method and in Mr. Crookes's apparatus was very plain. Mr. Crookes proposed a substitute for the disc of the photometer, but what the writer proposed might be used either with the disc or with Mr. Crookes's pith bar, being simply a substitute for the candles as a standard. Mr. Wills had referred to a point on which he had made a number of experiments—viz., the possibility of judging the illuminating power of gas by mixing it with air, but though he had had a very complete apparatus made for the purpose, he did not find it answer. He passed the air and gas through two meters, mixed them thoroughly, and was able to read off exactly the quantity of each, but he found that this proportion was not independent of the absolute quantities which were being used. At first he thought, with Mr. Wills, that a certain kind of gas, mixed with a certain proportion of air, would give a non-luminous flame; but this did not prove to be the case, the reason being that gas burning as in a Bunsen burner had not only the oxygen of the air mixed with it to cause its combustion, but also a certain quantity derived from the external air, and the amount of this would vary with the size and shape of the flame. When at a previous time he had gone more fully into the question of sulphur compounds than he had had time for on the present occasion, he had mentioned the experiments of Mr. Bowditch; but he thought that gentleman had been under a little misapprehension in insisting too much on the action of the clay which he used, because any other heated material would have produced the same effect. Mr. Fewtrell thought olefiant gas was the only proper gas to use as a standard, but in this he could not agree. Olefiant gas was to a considerable extent soluble in water, and the solubility differed according to the temperature, and therefore a mixture containing olefiant gas, if stored in an ordinary gasholder over water, would vary with the temperature of the room. It was also much more troublesome to make, while he could not see that it had any advantage over the mixture he had employed, which at the reduced pressure was thoroughly permanent. The mixture contained about 91 parts of hydrogen to 9 of petroleum vapour, so that the latter was under a pressure of only about one-tenth of an atmosphere. He had not tried directly the effect of any considerable alteration of pressure, but it would be very easy to do so. He felt little doubt, however, that with a gas formed from a liquid with so low a boiling point, which showed no perceptible variation when reduced to the freezing point, its volume might be reduced to a much greater degree than ever happened in ordinary atmospheric fluctuations, without any of it being converted into liquid. At the same time he agreed that this point ought to be definitely ascertained before such a method was accepted. He felt little doubt, however, that you might increase the pressure upon the gas from 30 inches of quicksilver up to 32 or 33, without producing any greater variation in volume than would be seen in an equal volume of hydrogen or air. With regard to the objection of Mr. Methven, it was ordinarily assumed that the temperature of gas was the same as that of the meter through which it passed; there was no reason to suppose that it retained the temperature of the mains through which it came. Besides, any variations due to temperature, which no doubt did affect the light of candles, would be entirely eliminated, because the temperature of the two meters close together would be the same, and the barometric pressure under which the two flames were burning would also be the same.

The CHAIRMAN said he had much pleasure in proposing a cordial vote of thanks to Mr. Harcourt, both for the labour he had devoted to these important problems, and for the pains he had taken to bring the results clearly before them. The sulphur testing apparatus was no doubt familiar to all present, though not in so simple and compact a form as it was now exhibited, nor had they before seen so simple an apparatus for making a gas of constant composition. There could be little doubt that the hydrogen being saturated to only a very limited extent with petroleum vapour, so that the latter was only under a pressure of 1-10th of an atmosphere, the gas would be permanent under ordinary changes of temperature and pressure. As to the remarks of Mr. Livesey, he had no doubt that if that gentleman would undertake to bring forward the public policy of the gas Acts, the society would afford him an opportunity of doing so, though he had felt that it did not come within the scope of that evening's discussion. He could not agree with some of the speakers as to the high merits of candles as a standard, for his own experience led him to the conviction that all improvements in gas-testing short of the introduction of a new standard would be almost labour thrown away. He did not dispute the results obtained by Mr. Hartley, but he thought a candle standard was very much like a yard measure of india-rubber; those who were very skilful in its use might manage to stretch it pretty evenly, but it might easily be made to measure less in one place and more in another.

The motion having been unanimously adopted, the proceedings closed with a vote of thanks to the chairman.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There has been very little business doing in this district during the week, many of the iron and steel works having been closed either up to Wednesday, or the whole of the week. The Atlas Works of John Brown and Co., Limited, and the Cyclops Works of Charles Cammell and Co., were closed all last week, and still remain so, a very serious dispute having now arisen between those companies and their men. The whole of the iron and steel producers were discharged on Saturday, the 15th of April, with the understanding that they could not resume work, except at a considerable reduction in their wages. On Wednesday, a deputation from the men waited upon the managers at each establishment, and an effort was made to come to terms, but no agreement was arrived at, and the interview was adjourned until Friday, when matters were again discussed. At the time of writing, the men are all out, and the works are to remain closed. It is stated that the employers wish to enforce reductions of about 15 per cent., and are determined not to reopen the works until the men are willing to resume on those terms.

It is, I think, owing to the miners strike, that the ironmasters are so persistent, seeing that no better time than this, when their supplies of fuel are stopped, could by any possibility be selected for endeavouring to get down the ironworkers wages. At the Northfield Works, near Rotherham, the whole of the puddlers have received notices of a reduction of 1s. 3d. per ton, and at the works of the Parkgate Iron Company, notices have been served, under which the men may be dismissed at a day's notice, in case the supply of fuel should fall short of the company's requirements. At the Thorncliffe Ironworks (Newton, Chambers, and Co.) the blast furnaces have been damped down; and at Sheepbridge and Staveley, the mechanics and some of the ironworkers have been served with notices for dismissal.

The colliers strike still continues throughout the whole of the two districts, there being now something like 30,000 men of this class out. Of this total about 14,000 are in Derbyshire, and 14,500 in South Yorkshire, together with 1800 in North Nottinghamshire. Besides these, there are large numbers of topmen out, and, contingently, a very considerable number of ironworkers. There is no prospect of a settlement being arrived at, both parties being apparently fully resolved to fight the matter out. Under these circumstances, it is not to be wondered that no business worth mentioning is being transacted.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

Owing to the Easter holidays, business has been practically suspended at nearly all the finished iron-works throughout the district; orders are very scarce, and it cannot be said that the prospects of the trade are less gloomy than last reported. Notwithstanding the decision of the leading firms to make no reduction in prices at present, the feeling among consumers and merchants is that a substantial reduction must soon be declared, and the natural influence of such an opinion is to restrict operations to all but the most urgent and pressing requirements; while merchants who hold stock manifest an anxiety to realize, even at a reduction, on the rates ruling before quarter-day.

In pig iron the market continues much depressed. The make has been reduced to a lower limit than has been known for many years, only 57 furnaces being now in operation, and the produce of not a few even of these is being put into stock. The action of the Shropshire smelters in reducing prices, to the extent of 10s. per ton, has not been generally followed by South Staffordshire firms; but prices are, as a rule, rather weaker, and the competition of Belgian and Prussian producers grows increasingly severe.

The event of the week, in local iron trade circles, has been the announcement of the conversion of the old and well-known firm of G. B. Thorneycroft and Co. into a joint-stock concern. The capital is fixed at £200,000. Four of the members of the old firm have accepted seats at the directorate of the new company.

The coal trade is just now very depressed, and there is every prospect of a number of the smaller collieries being closed until trade revives. Coalowners complain that the excessive cost of raising all but the best measures, renders coal-mining in this district unprofitable, even were orders to be had at current rates. In the Cannock Chase district the demand has somewhat improved since the recent reduction was declared, but the supply continues to be in excess of the requirements.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is very little that is fresh to report with regard to the position of the coal trade of this district. The demand for all classes of round coal continues extremely dull, and there is a good deal of competition wherever there is a large order offering, which has a natural tendency to weaken the market. In fact, the market is now so much cut up with this kind of competition, that several of the large firms have decided to close some of their pits altogether, as it is impossible, in the existing state of things, to work them to a profit. So far as quotations are concerned, they are without material alteration from those last given, best Arley coal at the pit mouth being quoted at 12s. to 12s. 6d., common at from 10s. to 10s. 6d., Pemberton four-feet at from 9s. 6d. to 10s. 6d., common coal 7s. 6d. to 8s., burgy 6s. to 6s. 6d., and slack 4s. to 5s. per ton, but with the exception of the last-named description of fuel, which is firm at full price; list rates do not indicate the real value of coal or the terms on which holders are doing business. I do not hear of very much stirring in gas coal, and none of the usual large contracts are yet being given out.

The shipping trade continues very flat, and the small amount of business doing is chiefly confined to low-class coals, which can be obtained at extremely low rates.

Wages questions are agitating several of the Lancashire districts. In the Bolton district the men are opposing a reduction of 30 per cent., but do not seem prepared to strike. In the Tyldesley district the threatened reduction has been withdrawn for the present, or until some action is taken in Wigan,

and in the latter district the matter is being talked about, but nothing definite has yet been done.

There has been an almost entire absence of business in the iron trade of this district during the past week. Most of the works have been closed for the holidays, and in some cases, owing to the scarcity of orders, the forges have been shut up for a fortnight. Prices nominally are about the same as last week, but there has been no demand to test what sellers would be really willing to take. Lancashire pig iron delivered into the Manchester district is quoted at about 61s. to 62s. 6d. per ton for No. 3 foundry, and about 60s. for No. 4 forge; Middlesbrough at about 57s. 3d. to 57s. 9d. for foundry, and 1s. less for forge numbers, merchants quoting 6d. per ton less. In the finished iron trade, buyers are holding off until the reductions, which were expected at the quarterly meetings, are made on the 1st of May. Nominally, ordinary bars delivered into this district are quoted at £7 7s. 6d. to £7 10s. per ton.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of the North of England is quite as firm as it was at the last report. If the strike in South Yorkshire were continuing, all kinds of Durham coals would improve in the market, as the Durham coal-field will be a good deal drawn upon to supply the Yorkshire iron factories with fuel to keep on the works. Steam coals are more in request, and the demand for shipment has greatly increased for the Baltic. The shipments of gas coals to the Mediterranean and Baltic are steady and improving. The quotations maintain about an average of between 8s. and 9s. per ton. The principal demand, however, is for best sorts. The pits on the Tyne are working better time.

The freights to load coals for London may be quoted at from 4s. 9d. to 5s. per ton for steamers; and for sailing ships, from 5s. 7½d. to 6s. per ton. Hamburg £6 5s. per keel. Business has been better for the Mediterranean, and a fair amount of trade has been done to the Italian ports, to Alexandria, and the Black Sea.

With the opening of the Baltic ports there has been a good demand for iron for shipment. Gas and water pipes are being placed aboard ship, and the foundry trade upon the whole is about the best employed branch of the iron trade business at present. There is a pretty good demand for fire-bricks and fire-clay goods generally, and several small vessels have been taken up to load. The steamers in the goods trade to London are loading up better, and the general condition of the goods trade, which depends upon the requirements of the manufacturers on the Continent, though not excessively brisk, is fairly satisfactory.

The chemical trade of the Tyne was duller last week. Little business was done. But the men sent in a demand to the masters of 20 per cent. upon their present rate of wages.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

Mr. Samuel Stewart, the manager of the Corporation Gas-Works, Greenock, seems determined to maintain his gas at a very high standard of illuminating power—so long, at all events, as his official superiors wish it. By-and-by, however, they may find out that they are getting gas which is far too rich to be consumed with the fullest measure of economy. The result of 25 testings, made during the month ending on the 11th inst., was an average illuminating power of 30·44 standard candles; yet still there are some people in Greenock who are not happy, for even at the last meeting of the Police Board a complaint was made that the gas was very bad!

During the week ending on the 15th inst., the maximum illuminating power of the Glasgow gas ranged from 26·17 up to 29·92 candles, and the average from 26·62 up to 27·66 candles. In no case did the minimum fall below 25 candles, which is that fixed by the Glasgow Corporation Gas Act.

The gas supplied by the two companies that divide Edinburgh between them is being kept up to a pretty high average illuminating standard. The report submitted by Mr. J. Falconer King, the official examiner, to the last Town Council meeting, stated that, on the 5th inst., the Edinburgh Company's gas had an illuminating power of 28·31 standard candles, and that it had a faint trace of sulphuretted hydrogen, and a distinct trace of ammonia; while that of the Edinburgh and Leith Company was equal to 29·40 candles, and that it also had a trace of ammonia.

There is a prospect of a difficulty arising in connexion with the gas supply of Newport, which is a sort of Fifeshire suburb of Dundee, and separated from it, of course, by the river Tay. The Newport Gas Company will not be responsible for the supply of gas to the very many new houses now building, unless they are connected with the mains by Whitsunday. In consideration of that prospective difficulty, and the very high price of gas in Newport, it has been suggested that a new company should be formed in the "suburbs," and that a contract should be entered into with the Dundee Corporation Gas Commissioners for a supply from their works, *viâ* the Tay Bridge, when it is finished. The price of gas for the last two years in Newport has been 8s. 4d. per 1000 cubic feet, with 5 per cent. discount to consumers who pay their accounts within 14 days.

At the last meeting of the Geological Society of Edinburgh, held last Thursday night, Mr. Andrew Taylor, F.C.S., exhibited a number of specimens of gas coal, which showed polished and grooved surfaces. His friend, Mr. Reid, of the Edinburgh and Leith Gas Company, had called his attention to the polished appearance so prevalent in some of the Scotch gas coals, and suggested that this was caused by the beds of coal sliding against each other from the enormous pressure of the superincumbent strata, when the gas which occupied the seams was disengaged. Mr. Reid had a further theory—that the pressure turned the gas into oil, and when that pressure was relieved, either by the opening up of the mine, or in any other way, the oil returned to the gaseous form, and caused the explosions, the source of which practical men were unable to trace.

The Police Commissioners of Inverurie have just settled contract No. 2 of their new water-works. Improvements have just been made in the Turriff water supply, by which the available quantity of water has been raised from 14,400 gallons to 21,600 gallons per day. Various drainage schemes are now actually in hand, or on the *tapis*. One of them is for the town of Ayr, and has just been reported on by Sir John Hawkshaw, whose estimate for it is £20,000.

Since last report, pig iron has been still further reduced in price. Some of the special brands have been reduced 6d. to 1s. per ton, and business was done in warrants on Friday down to 58s. 3d. to 58s. 1½d. cash. At the close the market was rather firmer, buyers offering 58s. 3d. cash, and sellers asking 58s. 4½d.

The dulness in the coal trade increases week by week, and any slight activity which was noticeable in the shipping department, on account of the North American timber fleet, has again died away. That fleet numbered at least 37 vessels this spring, almost all of which were laden with coals. The approach of warm weather lessens the demand for house coal. Local trade shows no appearance of improving soon, and altogether the prospects of the Glasgow coal market are at present very gloomy, warranting lower prices, and consequently lower wages. The following are the quotations free on board at Glasgow Harbour cranes:—Wishaw Main coal, 7s. to 7s. 6d. per ton; house coal, 8s. to 10s. 6d.; splint coal, 8s. to 8s. 9d.; steam coal, 9s. to 10s.; smithy coal, 13s. 6d. to 14s. Notices of reduction of miners wages have been given in almost all the colliery districts of Scotland, and in some instances they have already taken effect, while in others they will take effect in a few days. The reduction generally ranges from 5 to 10 per cent., but there are intances where it amounts to as much as 1s. per day. It is not likely that any serious opposition will be given by the men in any district where the reduction is announced.

NEW GAS COMPANIES.—A company has just been registered for erecting gas-works and for supplying gas and gas products to the inhabitants of Cranleigh, Essex. The capital is £3000 in £10 shares. Another company has been registered, to take over the business and property of the Epsom and Ewell Gas Company, which was constituted by deed of settlement in 1839. The capital is £50,000 in £25 shares. The purchase consideration is £22,500 in fully-paid shares, to be issued to the proprietors in the old company; that sum being the amount of the present share capital.

KEIGHLEY NEW GAS-WORKS.—The site of the old gas-works belonging to the Local Board of Keighley having been acquired by the Great Northern Railway Company for station and other purposes, in connexion with the line from Halifax, the Gas Committee obtained land at Thwaites for the erection of new works, which have now for some time been in progress, under the superintendence of their engineer, Mr. John Laycock. The works are being so arranged as to admit of very considerable extensions when required.

RICHMOND WATER SUPPLY.—The Southwark and Vauxhall Water-Works Company have determined to abandon further proceedings to restrain the Vestry of Richmond from constructing water-works to supply their district. At the meeting of the vestry on Tuesday last, it was stated that the Public Works Loan Commissioners had agreed to lend to the local urban sanitary authority the sum of £28,000, on the security of the rates, for the purpose of making an artesian well. The money is to be lent at 3½ per cent., and repayable by instalments spread over a period of 30 years.

REDUCTIONS IN THE PRICE OF GAS.—The directors of the Sheffield Gas Company have determined to reduce the price of gas on the 1st of July next to 3s. per 1000. At a meeting of the Gas Committee of the Corporation of Leeds on Thursday last, it was resolved to recommend a reduction in the price of gas, from the 1st of July next, of 6d. per 1000, that is, from 3s. 9d. to 3s. 3d. per 1000. The question of abolishing discounts to large consumers was briefly discussed, and it was decided to leave the subject over for the present. The Gas Committee of the Stockport Corporation, at their meeting on the 6th inst., resolved to reduce the price of gas from the 31st ult. as follows:—1000 feet to 500,000 feet, 4s. per 1000; 500,000 feet to 1 million feet, 3s. 11d. per 1000; 1 million feet and upwards, 3s. 10d. per 1000. In September last the price was reduced from 4s. 4d. and 4s. to 4s. 2d. and 3s. 10d. Cannel gas only is supplied at Stockport, the illuminating power averaging 22·5 candles. The profit on last year's working was, we believe, 11½ per cent. At Burnham, the price is reduced from 7s. 6d. to 6s. 3d.; and at Kelvedon, from 7s. 6d. to 6s. 8d.

HULL GAS SUPPLY.—The gas sent into the district of Sculcoates and Myton during March by the British Gas Company averaged 16 candles illuminating power. Free ammonia and sulphuretted hydrogen were at no time present to the ordinary tests. The results for the month are—

	Max.	Min.	Mean.
Illuminating power standard sperm candles	16·40	15·75	16·02
Grains of sulphur per 100 feet	32·00	28·00	29·00

Mean barometer and temperature in experiment-room:—Bar., 29·56; tem., 56°.
James Baynes.—*East District:* The following are the results of an examination of the gas sent into this district during March by the Sutton, Southcoates, and Drypool Gas Company:—

	Max.	Min.	Mean.
Illuminating power standard sperm candles	16·21	15·87	16·06
Grains of sulphur per 100 feet	—	—	8·64

Mean barometer and temperature in experiment-room:—Bar., 29·51; tem., 57°.
James Baynes, jun. Sugg's 15-hole elliptical burner used in both districts.

DARLINGTON CORPORATION GAS SUPPLY.—Complaints having been made to the Gas Committee, by some of the consumers, of an excessive consumption during the last half year, the consideration of the question was referred to the engineer, who has made a report thereon, in which he says: "I am of opinion that the large consumption for the half year ending the 31st of December last is owing to our large mains being laid throughout the town. Before those mains were laid, consumers could not get a sufficient supply of gas, as is shown by Mr. Laidlaw's report of Dec. 2, 1874. According to his testings the pressure at the burners ranged from one inch to 8-10ths of an inch. At Woodburn the pressure was 5-10ths, whereas, when the new mains were laid, the pressure at that place was 1½ inches, or 15-10ths. The consumers now have it in their own hands to burn a large or small quantity as they deem necessary. I am also of opinion that a large quantity of gas is wasted by bad gas-burners, and would recommend all consumers of gas to put in Bray's No. 8 burners, and turn on the stop-cock at the meter to give them the supply they require, and no more. If they attend to this they will, I have no doubt, have a better and a cheaper light." The Gas Committee have agreed to reduce the charge for the public lamps from 65s. to 55s. each from the beginning of the year.

NOTTINGHAM CORPORATION GAS-WORKS.—An adjourned meeting of the Nottingham Town Council was held on the 10th inst., when the Gas Committee reported that they had received from the engineer a report on the present condition of the works at Radford, and on the necessity for considerable extensions and improvements thereto This manufacturing station occupies an important position in relation to the supply of Beeston and the western districts, and it is necessary to increase the manufacturing power of the works, and also to alter some of the mechanical arrangements. It is proposed, ultimately, to duplicate the present carbonizing-house, and at once to substitute clay for iron retorts in the present house. Anticipating future extension and the change in the retorts for carbonizing, the committee state it will be necessary to erect a small engine-house, and to put down a pair of engines, boilers, and exhausters, on similar principles to those at the Basford works. For the purpose also of obtaining a better delivery of the ammoniacal liquor and tar, it is proposed to erect cisterns and tanks over the engine-house, and also to pump the water supply in future from a well to be sunk on the premises. These operations will economize the manufacture of gas at this station, and sufficient land exists for all the purposes of the proposed extension. The present four gasholders at these works are almost worn out. The storeage power is also very limited, and the committee propose to double the storeage in the course of time by erecting new telescopic gasholders in in place of the present old ones. This work may be extended over some 12 or 18 months, but it will be necessary at once to put in hand one or two of these gasholders. The probable cost of the present outlay will amount to about £7000. They further reported that it has become necessary to extend the gasholder accommodation at the Nottingham works. Calculations have been made by the engineer, by which it has been shown that a considerable pecuniary advantage will arise from increased storeage at these works. During the past winter great loss had been sustained from having to let out the retorts, for many hours at a time, in consequence of not having space to store the gas. The effect of this is very destructive to the retorts, and expensive both in labour and wear and tear. The proposed new gasholder will be telescopic, 90 feet in diameter, and will occupy the vacant piece of land between the superintendent's house and the large purifying-house. When this gasholder is constructed, it will bring up the Nottingham works to their maximum producing capacity for storeage. The estimated cost is £11,000. The cost of the above extensions will have to be defrayed out of new capital, which the committee asked that they should be authorized to raise under the provisions of the Nottingham Corporation Gas Act, 1874. The report and recommendations were adopted by the council.

INVERCARGILL (NEW ZEALAND) GAS-WORKS.—The *Southland Times* of the 4th of February last gives a lengthy account of the ceremony connected with the opening of these works, which took place on the previous day. His Worship the Mayor (Mr. Mitchell), all the members of the Municipal Council, and about 30 to 40 gentlemen, including Mr. W. Wood, M.H.R., were present; Mr. Genever, engineer of the Dunedin Gas-Works, and Mr. W. Daley, engineer of the Invercargill Gas-Works, were also in attendance. The entrances of the buildings were tastefully decorated with fern, broadleaf, and other green foliage. The Mayor and each member of the council then placed two or three shovelsfull of coal in one of the furnaces, and the retort was properly charged. The health of the Mayor was then drunk in champagne, and the name of Mrs. Mitchell was included in the toast, which was received with three cheers. The Mayor, in acknowledging the honour done him, said that when the gas-works were undertaken, the council and himself knew next to nothing about gas. They knew a good deal more, however, now. They were fortunate, at the time he spoke of, in having Mr. Genever to give them good advice. He supplied the council with the name of a gentleman fully acquainted with the subject, and told them to give him full discretion in supplying the plant. The plant sent out to them by Mr. Bower was second in quality to none in New Zealand. Mr. Bower sent out not merely a good plant for the works, but also a good man in Mr. Daley to superintend their erection. The time would come, perhaps before two years were over, that the gas-works would be a profitable undertaking. He had doubts on that subject at one time, but had none now. The lighting of the streets with gas would attract population, and would be a great boon to all the residents. Perhaps the next occasion of this kind would be in connexion with the supply of water to the town; but that could not be just yet, on account of the large amount of money required for the construction of the works. He believed, however, that in course of time the difficulties in connexion with that would also be overcome. The Mayor then broke a bottle of champagne on one of the furnaces, and declared amidst cheers the Invercargill Corporation Gas-Works opened. The healths of Mr. Genever and Mr. Daley and other gentlemen were then proposed and cordially responded to, after which the Mayor turned on the gas to the town, and each of the members of the corporation in succession lighted a jet in front of the buildings. In the evening the Council Hall was illuminated with a large Brunswick star with the letters V. R. in the centre. A large number of persons assembled on the spot, and the Volunteer brass band was present to lend additional *éclat* to the occasion.

SHEFFIELD WATER SUPPLY.—The water supply of Sheffield, which was at the last census just second to Leeds in point of population, but is now in all probability first in this respect, has been brought to a state of great efficiency and thoroughness of late years, mainly under the engineering direction of Mr. T. Hawksley, C.E. The old gathering-grounds of these water-works reservoirs are situated at Redmires, one of the highest points of the Derbyshire Peak range of hills, where a very large area of moorland, nearly 5000 acres, is drained into three reservoirs, each having many acres of surface when filled. From the lowest of the three the water is conveyed in an open culvert to the Wyoming Brook, whence it flows down to the Hollow Meadows compensation reservoirs. These latter regulate the quantity sent down to the millowners on the Rivelin stream. The principal gathering-grounds, however, are those in the valley of the rivers Don and Loxley, at Strines, Bradford Agden, and Dam Flask. Here there are four reservoirs of huge size, constructed in the most approved manner. The Dale Dike dam is one of these. It burst in 1864, on the 12th of March, causing the loss of 240 lives, flooded and destroyed 4697 houses, besides 927 mills and works, and did damage to the extent of nearly £400,000. The present Dale Dike reservoir is not so large as the former one, the new embankment being only 300 yards long as against 420 yards. It has now a water area of 60 acres, is 80 feet deep, and contains about 500 million gallons. This and the Strines storeage reservoir together drain an area of 10,725 acres, which yield over 12 million gallons daily on an average. The Agden reservoir is about 100 acres in water area, and drains 3000 acres of about 4 million gallons daily. The Dam Flask reservoir is nearest the town, most recently completed, and the largest of the whole series. It has a water surface of 120 acres, contains 1250 million gallons, and receives the water from a very wide gathering-ground. Its embankment is considerably over 1000 feet wide at the base and of corresponding strength. Its bywash is 120 feet wide at the base, and 75 feet at the upper end. From this reservoir a 24-inch main has recently been laid for the supply of certain districts of the town. The company's scheme is not yet finished, but the remaining two reservoirs which have to be constructed in the Ewden Valley are not yet put in hand, as the present reservoirs are ample for the supply of a population of 500,000, although compensation water to the millowners is to the extent of 8 million gallons daily. The water is exceedingly soft, and in analysis yields no traces of organic or chemical pollution, except a slight peaty colouring, which is lost before the water reaches the town. During the past year the company laid about 10 miles of pipes of various sizes, the entire length now possessed being nearly 200 miles. Over 54,000 houses, besides works, shops, mills, &c., are supplied by the company, the income of which during the year 1875 from water-rates, mill-rents, &c., was £61,000. The rates are levied in a fixed scale according to the rental, and were augmented to the extent of 25 per cent. by special Act of Parliament, obtained immediately after the bursting of the Dale Dike reservoir in 1864. After 1899 they lapse to the former level.—*Engineer*.

THE LATE MR. JOHN AIRD.—We announce with regret the death of Mr. John Aird, sen. (head of the well-known firm of John Aird and Sons), which took place on the 9th inst. in London. We learn from the *Elgin Courant* that Mr. Aird was a native of Ross-shire, but left Scotland when a mere boy. When a young man, he was employed in the construction of the Phœnix Gas-Works in London. His superior knowledge, skill, and character attracted notice, and he was, after a time, placed in charge of some departments of the work, and then entrusted with contracts on his own account. Ultimately he left the gas company, and, when contractors were asked to estimate for works that he saw his way to undertake, the young man from the far north competed for them, and, having his early friend, Mr. Munro, formally engineer to the Phœnix Gas Company, to stand by him until he became better known, he got into business. At first his transactions were on a small scale, but, as it became known that his fixed principle was to execute whatever was entrusted to him in the most substantial and perfect manner, the sphere of his operations rapidly extended. From one point to another his business rose to be one of the largest in the kingdom. He took gas and water into Berlin, where he laid down some 80 miles of pipes, and so satisfactorily did he carry through these works that the Government presented him with a testimonial and the freedom of the city. He took water also to Amsterdam, a work of very great difficulty, and had large contracts in Rotterdam, Schiedam, Hamburg, Archangel, Singapore, Copenhagen, and other places. At Copenhagen he carried a tunnel under an arm of the Baltic, 70 feet below it, and lost a large sum of money by it, as it turned out to be of sulphurous stone, in which the men could work only an hour or two a day. But he never failed to finish what he undertook, whatever it cost, and thus he was often preferred to others when estimates came to be considered, though he was not the lowest offerer. In Ottawa and in places in America extensive contracts were entered into by Messrs. John Aird and Sons (for when his large family grew up, Mr. Aird took two of his sons into partnership, and they have in recent years chiefly conducted the business). Friendships led them to undertake one or two small contracts in Scotland. The Buckie Water-Works were executed by them. To the village of Urquhart and to Innes House Messrs. John Aird and Sons brought water from Lochnabo. Gas and water works they erected without number. In London they had a large share of the works going on. At Christmas, 1874, a reckoning was made of the people in their employment in various parts of the world, and they were found to be considerably over 30,000. The strength of the firm of John Aird and Sons was brought into special notice by the money crisis of 1867. Sir Morton Peto, Betts, and Co., who had then perhaps the largest contracts of any firm in the world, succumbed under the monetary pressure of that time, and Messrs John Aird and Sons, in the great majority of cases, took up their contracts, and finished them. Mr. Aird, who was seventy-six years of age at the time of his death, is spoken of in the highest terms for his amiability and good-heartedness.—*The Builder*.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

1405.—ALLAN, A., jun., Scarborough, "Improvements in pressure and vacuum gauges." April 1, 1876.

1426.—HOLMES, J. M., Birmingham, "Improvements in gas-stoves or gas apparatus for heating and cooking." A communication. April 3, 1876.

1466.—LAKE, W. R., Southampton Buildings, London, "Improvements in the manufacture and utilization of combustible gases, and in apparatus therefor." A communication. April 6, 1876.

1499.—LOUTTIT, K. M'L. P., Greenwich, "Improvements in the manufacture of gas for heating and lighting purposes." April 8, 1876.

1520.—WIRTH, F., Frankfort-on-the-Main, Germany, "Improvements in gas-engines." A communication. April 10, 1876.

1532.—SCRATTON, G., Stickney, Lincoln, "Improvements in apparatus for raising water, the same being applicable as ship-pumps." April 11, 1876.

1547.—WILDY, W. L., Camden New Town, London, "Improvements in cocks and valves." April 11, 1876.

1566.—TYLOR, A., Newgate Street, London, "Improvements in water-closets, lavatories, and other apparatus relating to sanitary arrangements, and the parts connected therewith, relating to the containing, measuring, controlling, arresting, and more convenient supplying of water and prevention of waste of the same." April 13, 1876.

1569.—NEWTON, H. R., Seymour Street, London, "Improvements in apparatus for the combined sanitary objects for supplying and regulating water filtered or unfiltered to houses, and in locking or fastening apparatuses therefor, and for discharging and separating waste and surface waters from houses and lands, and in the construction of drains, sewers, and connexions therefor, parts of all of which methods of construction and apparatuses are applicable to other useful purposes." April 13, 1876.

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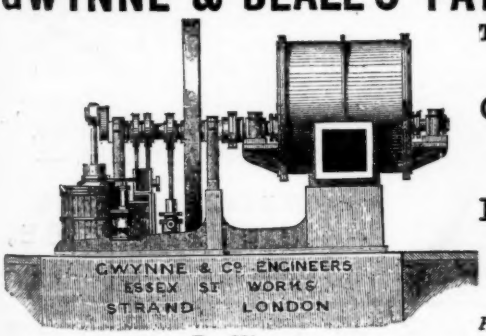

FIG. 224.

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FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 62,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

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State lowest price, and where to be seen, to Mr. ISAAC KELSALL, Buckley Chambers, ASHTON-UNDER-LYNE.

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WANTED, for Holyhead Gas-Works, a competent MANAGER and Fitter, to take charge of the works and property of the Company. Must be able to keep accounts, execute any fitting required, &c. Salary £1 10s. per week, with residence, rent, taxes, coals, water, and light free on the works.

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The whole Manufacturing Plant, Gasholder, and Governor, of a small Gas-Work, capable of producing 10,000 cubic feet of gas per day. The gasholder is 27 ft. diameter by 14 ft. deep, cubic contents 8000 ft.

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A 6-h.p. Patent Trunk Engine. (Beale.)

Cylindrical Egg-ended Boiler, 20 ft. by 4 ft. 6 in. (Beale.)

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Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.

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A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.

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The Directors do not bind themselves to accept the lowest tender.

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THE Directors of the Milnrow Gas Company invite TENDERS for the construction of a Telescope GASHOLDER, 70 ft. diameter.

Plans and specifications may be seen at the Office of the Company, on and after the 25th inst.

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Sealed tenders to be sent in, on or before May 16, 1876, addressed to the CHAIRMAN of the above Company.

TO MANUFACTURING CHEMISTS AND OTHERS.

THE Keighley Local Board of Health invite TENDERS for the TAR and AMMONIACAL LIQUOR produced at their Gas-Works for a term of Three years, commencing on the 1st day of July next. The Tar and Ammoniacal Liquor will be delivered into tanks on the Midland Railway Company's sidings, at Keighley.

Particulars and forms of tender can be obtained on application to the undersigned, at the Gas-Works' Offices, Low Bridge, to whom tenders must be sent not later than the 1st day of May next.

By order,
JOHN LAYCOCK, Superintendent.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Birkenhead Improvement Commissioners invite OFFERS for the purchase of the whole of the AMMONIACAL LIQUOR and surplus TAR produced at their works, for Two, Three, or Five years.

Further particulars can be obtained from the Engineer, at the Gas-Works.

Offers, addressed to the Chairman of the Gas and Water Committee, 50, Hamilton Square, to be sent in on or before the 12th of May next, and marked on the envelope "Offers for Tar and Ammoniacal Liquor."

The Commissioners do not bind themselves to accept the highest or any offer.

By order,
AMBROSE WALU, Clerk to the said Commissioners.
Birkenhead, April 20, 1876.

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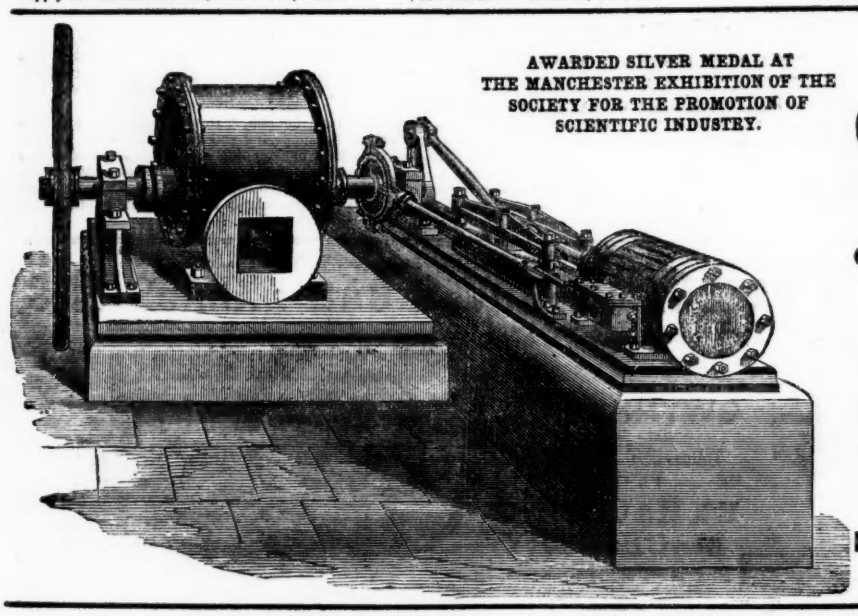

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ESTIMATES FOR GAS-WORKS OF ANY SIZE.

REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—It is most particularly requested that all Communications be addressed to the FIRM ONLY, as circumstances have arisen which render this necessary.

GAS SHARES.

MR. SANDELL, Gas Companies Accountant, having several inquiries by capitalists desirous of investing, would be glad to hear from holders desirous of selling, and also from those desirous of buying.

Address 4, Skinner's Place, Size Lane, LONDON, E.C.

G. A. BAILEY AND CO., Machinists, Manufacturers of all kinds of Indexes for Gas and Liquid Meters, Tell-Tales for Turnstiles, on an improved principle. Every description of Wheel and Worm Cutting any size, &c.

86, Crampton Street, Newington Butts, LONDON, S.E.

N.B.—Country Orders executed with despatch.

CATHELS'S Patent District Dry Gas-GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, ROTHERHAM.

CATHELS & TERRACE'S Patent Four-WAY DISC GAS-VALVE is the simplest and best Valve for Purifiers, and as a By-pass for other apparatus in Gas-Works. It is always gas-tight, and has no springs, ground faces, or other delicate parts. By its use the flow of the gas cannot be accidentally stopped, and it never sticks.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, Foundry and Brass Works, ROTHERHAM.

ALLIANCE & DUBLIN CONSUMERS GAS COMPANY.

THE Directors of this Company are prepared to receive TENDERS for a supply of best screened Newcastle and Wigan GAS COAL, in such quantities as may be required in Twelve months, from the 1st of July next.

The probable quantity required being about 80,000 tons, parties tendering can do so for the whole quantity, or from 10,000 tons upwards.

The Coal must be fresh, of the best quality, properly cleaned, free from dust, stones, pyrites, and all other impurities.

Tenders must state and name the locality of the pit, and the particular seam from which the Coals offered are to be supplied.

The Contractors will be bound to supply the Coal strictly in accordance with an analysis, which must accompany each tender.

The Directors do not bind themselves to accept the lowest or any tender.

Tenders, stating price f.o.b. Tyne, Maryport, and Silloth, also delivered at the Company's Works, Dublin, must be lodged in my Office on or before the 1st of May next, endorsed "Tender for Coal."

By order,
W. F. COTTON, Secretary and Manager.

Gas Office, 114, Grafton Street, Dublin.

COALS.

THE Directors of the Tunbridge Wells Gas Company are prepared to receive TENDERS for the supply of 5500 tons of either Pelaw Main, Lanchester Pelaw, or New Pelton GAS COALS, at the option of the Directors, in accordance with terms and conditions to be obtained on application to the Secretary.

Tenders to be forwarded to the Office of the Company, Tunbridge Wells, by not later than Six o'clock p.m., on Wednesday, the 10th of May next, addressed to the Secretary, and marked "Tender for Coals."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
JOHN READ, Secretary.

Tunbridge Wells, April, 1876.

ALTON GAS COMPANY.

TENDER FOR GAS COALS.

THE Directors of the Alton Gas Company invite TENDERS for the supply of 800 tons of best GAS COALS, during the Twelve months between the 1st of May, 1876, and the 1st of May, 1877.

The Coals to be partly small and partly large, and to be delivered in such proportions as may be required, in accordance with the season.

The quality of the Coals must be good, dry, and as free as possible from sulphur, bats, refuse, and dirt.

The Directors will be glad to receive analyses of such coals, and any information in relation to their properties for the manufacture of gas.

Tenders to state price per ton to Alton Station.

Tenders to be sent to the Manager, at the Gas-Works, Alton, Hants.

F. BARNLEY, Manager.

April 22, 1876.

RICHMOND GAS COMPANY.

COALS.

THE Richmond (Surrey) Gas Company wish to receive TENDERS for about 6000 tons of COALS, viz.:

3000 tons of best inland, either Dodsworth, Old Silkstone, Limehurst, Strafford, or Arley Mine.

3000 tons of Newcastle, either New Pelton, Ravensworth Pelaw, Pelaw Main, Waldridge, Holmside, or East Castle.

To be delivered into the Company's Works (as directed by the Manager) free of all expense, to be weighed by their weighing machine, and paid for accordingly.

Cash monthly.

The company have a railway siding about 200 yards from their works.

If Coals are sent by barge the nearest point is Mortlake, about one mile from the works.

Quantities Required.

In May	300 Tons.
June	500
July	600
August	600
September	700
October	1000
November	1100
December	1200
Total	6000 Tons.

Further particulars may be obtained on application to Mr. Eldridge, the Manager.

Sealed tenders to be addressed to the Chairman of the Richmond Gas Company, on or before the 2nd day of May, 1876.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
E. B. BLOTT, Secretary.

Richmond, Surrey, April 21, 1876.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

D. M. NELSON,

48, GORDON STREET (late 135, BUCHANAN ST.),
GLASGOW,

Supplies every requisite in connexion with the distribution of Gas and Water.

Estimates and prices on application.

WOOD GRIDS for Purifiers and Scrubbers.

Cast-Iron PIPES and VALVES.

Street LAMP-PILLARS.

Patent Pipe SCREWING-MACHINES, &c.

Just published, price 10s. 6d.,

REGISTRATION OF DISTRIBUTORY PLANT.

The forms for this purpose are to illustrate the Paper on Distribution of Gas, read at the Edinburgh Meeting of the British Association of Gas Managers. By the use of the synopsis the whole of the out-door plant may at once be seen, with all matters pertaining to the same.

W. J. WARNER, Engineer.

South Shields.

WATER-MAINS.

COTTERILL'S PATENT STEEL TUBE-DRILLS,

for connecting services to water-mains, *under pressure*, without turning off the water. They drill and tap themselves, and are left in the mains. Made of all sizes, from ¾ to 2 inches and upwards. They cost less than the ordinary plan.

Apply to CHARLES FORSTER COTTERILL, Cannock, STAFFORD, Patentee.

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CHESTER-LE-STREET,
DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. MANWARING, 101 Cannon Street, E.C.

J. T. B. PORTER & CO.,

GAS ENGINEERS & CONTRACTORS,

LINCOLN,

AND 1, WESTMINSTER CHAMBERS, LONDON, S.W.

Estimates for Works of any Size.
References to 500 Works already Erected.

MOBBERLEY & PERRY,

FIRE CLAY and BRICK WORKS,

STOURBRIDGE.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAY.

Manufacturers for Home and Export.

GAS-RETORTS, GLASS-HOUSE FURNACE,

BLAST-FURNACE, TANK BRICKS, LUMPS, TILES,

And Every Description of Best Fire-Bricks.

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ANTI-CORROSIVE COMPOSITIONS.

SZERELMEY IRON PAINT having been in use for upwards of twenty years, has stood the test of time. SIR CHARLES BARRY reported to the Chief Commissioner of Works (in 1859) that the Iron Roofs of the Westminster Palace, coated in 1856, "Still afford the most convincing and satisfactory evidence of its efficacy," and anyone who looks at the work now, in 1876, will see the same evidence.

THE Undersigned have, by means of extensive machinery and improved processes, succeeded in reducing the price of the Szerelmey Iron Paint, that which was formerly sold at £35 they now supply at £33, and make other kinds, commencing at £20 per ton, including Black, Purple, Chocolate, Red, Green, Blue, Bronze Green, Grey, White, and various tints.

THE Szerelmey Liquid Enamel, sold ready for use, is the cheapest Anti-Corrosive Composition ever produced; it dries in four hours.

SZERELMEY Stone Paint thoroughly waterproofs brick and other walls without giving them the appearance of having been painted.

COPIES of the Reports of Sir Charles Barry, Sir R. J. Murchison, and Professor Faraday (printed by order of the House of Commons), with twenty years of favourable testimony,

Price lists, discounts, and all particulars may be had of

N. C. SZERELMEY & COMPANY
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Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

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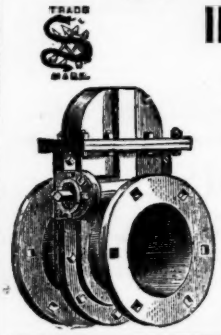
IMPROVED GAS-VALVES



WITH WROUGHT-IRON PINIONS,

List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.

VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO, SCREW WATER-VALVES WITH GUN-METAL FACES.

ALSO SOLE MAKERS OF
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CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS, VESTIBULE LAMPS, AND THE PATENT CRYSTAL ILLUMINATION.

A LARGE STOCK ALWAYS IN HAND OF

IRON, BRASS, COMPOSITE, AND LEAD TUBES, FOR GAS AND WATER,

AND EVERY DESCRIPTION OF

GAS AND WATER FITTINGS.

THE PATENT DRY AND WET METER, WITH THE LATEST IMPROVEMENTS.

STREET LAMPS AND COLUMNS IN GREAT VARIETY.

WORKS: LONDON AND BIRMINGHAM.

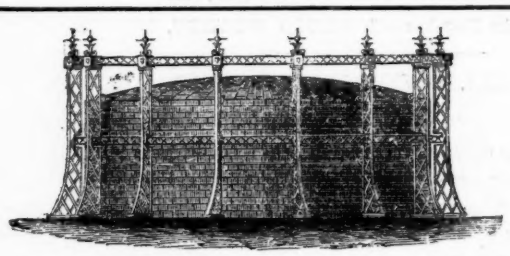
GAS MOONS,
Cut and Engraved, of the newest designs

GAS REFLECTORS
In Silver and Glass

GAS NIBS
AND
BURNERS
Of every description.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1876, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.
ESTABLISHED 1830.



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LIMITED,

TIPTON, STAFFORDSHIRE.

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GAS ENGINEERS, IRONFOUNDERS, &c.,

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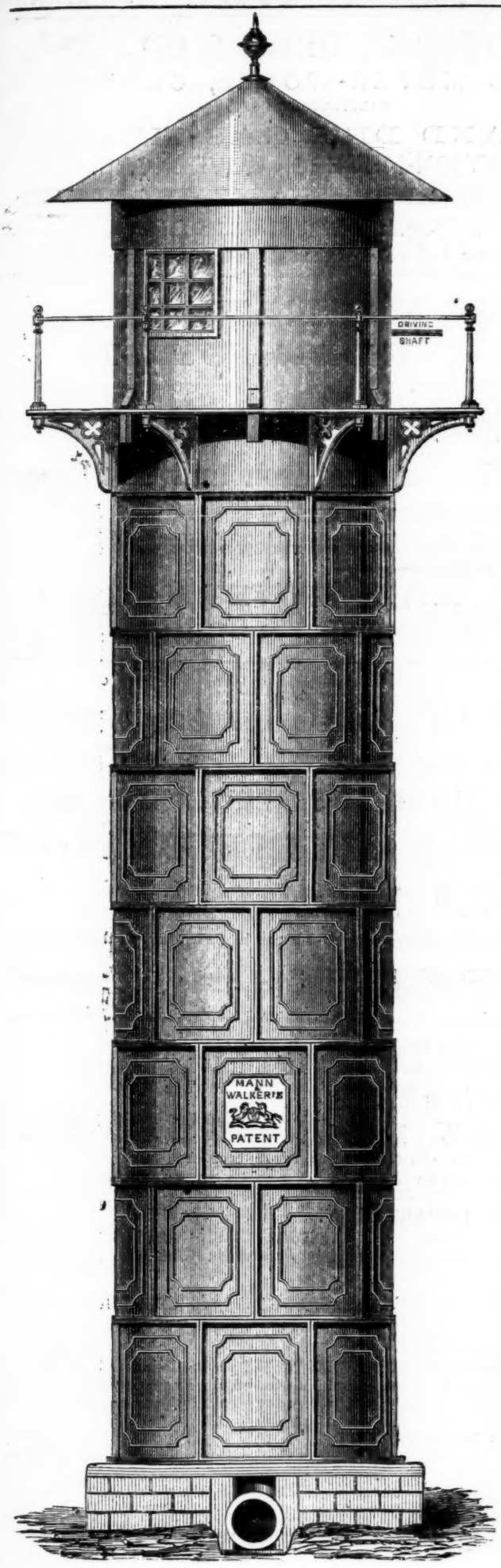
AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.



C. & W. WALKER,
8, Finsbury Circus,
London, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im-portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, re-quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. and W. Walker, 8, Finsbury Circus, London, E.C., or to Mr. William Mann, late Superintendent of the Chartered Gas-Works, Blackfriars, London; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,
Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
CHARLES HORSLEY, Agent.

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WET AND DRY GAS-METERS,
STATION-METERS, GOVERNORS,
PRESSURE AND EXHAUST REGISTERS,
LAMP-METERS IN CAST-IRON BOXES,
And every Description of Gas Apparatus.

ALDER AND MACKAY,
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MANUFACTURERS OF
CONSUMERS IMPROVED GAS-METERS;
IMPROVED DRY GAS-METERS, in Cast-Iron and Tin Cases,
OF THE HIGHEST EXCELLENCE,
Warranted to measure correctly, and not to vary.
STATION METERS AND GOVERNORS,
EXPERIMENTAL METERS, PHOTOMETERS, GASHOLDERS, &c.

GAS PURIFICATION & CHEMICAL Co., LIMITED,
(Successors to JOHN WILLIAM O'NEILL & CO.,)
Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,
CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.
The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.
JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON, } Joint Managing Directors.

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GAS ENGINEERS,
WORKS: COMMERCIAL ROAD, EXETER,
INVITE THE ATTENTION OF GAS COMPANIES AND OTHERS FOR THE SUPPLY OF
EVERY DESCRIPTION OF GAS APPARATUS.
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NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.
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They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.
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An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.
PATTERN-BOOKS and PRICE LISTS furnished.
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GAS ENGINEERING WORKS, COMMERCIAL ROAD, EXETER.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

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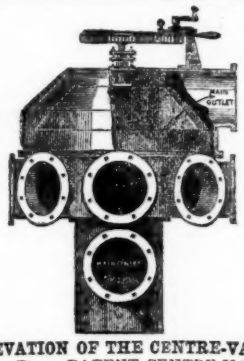
This Paint having been in general use over fourteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

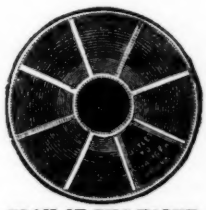
The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

SPECIAL DRIERS FOR ANTIMONY PAINT SUPPLIED.



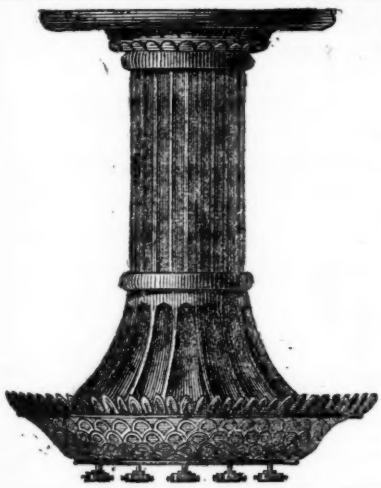
C. & W. WALKERS' PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE. PLAN OF THE VALVE. PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.



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GAS AND HOT WATER ENGINEERS,

155, CANNON STREET, E.C.

Manufactory: 19 & 20, NICHOLAS LANE, E.C.

SUN-BURNERS,

With Regulating Valves to obviate down draught.

MEDIÆVAL & OTHER GAS-FITTINGS

For Churches and Domestic Use.

ARCHITECTS' OWN DESIGNS WORKED OUT.

ESTIMATES FREE OF CHARGE.

THE TRADE SUPPLIED.

SOLE CONSIGNEES FOR BRÖNNER'S IMPROVEMENTS IN GAS LIGHTING.

IN THE MATTER OF

BRÖNNER'S GAS-BURNERS.

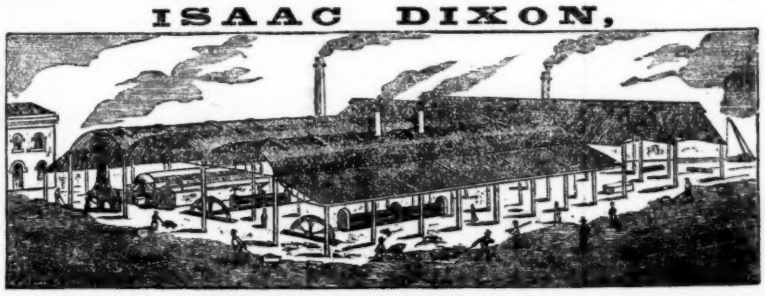
HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

ISAAC DIXON,

WINDSOR IRON-WORKS, LIVERPOOL.



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Manufacturer of SELF-SUPPORTING GALVANIZED CORRUGATED, CURVED, and every kind of IRON ROOFING, CHURCHES, SCHOOLS, SHEDS, and IRON BUILDINGS.

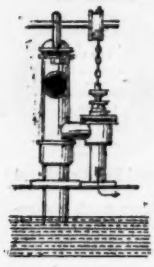
WROUGHT and CAST IRON GIRDERS, BRIDGES, TANKS, &c., and all kinds of WIRE WORK, FENCING, GATES, HURDLES, &c., for Home or Abroad.

DIXON'S CELEBRATED SELF-SUPPORTING IRON ROOFS are specially suitable for Forges, Rolling-Mills, Iron-Works, Shipbuilding Yards, Mines, Collieries, Gas and Water Works, and for general purposes.

For Roofs with Timber Framing, DIXON'S GALVANIZED OR TARRED IRON SLATES form a durable and cheap covering, costing only about the same, when fixed, as felt and boards.

DRAWINGS, ESTIMATES, AND ILLUSTRATED CATALOGUES MAY BE OBTAINED ON APPLICATION.

COPP'S PATENT ANTI-DIP GAS APPARATUS.



Produces from 10 to 20 per cent. more gas of higher illuminating power.
Prevents the deposit of carbon.
Retorts last much longer.
Charges work off quicker.
This simple invention has been in use in many works for the last six months, with the above results.

PRICE 2 GUINEAS EACH.

Testimonials and particulars on application.
Address WALTER L. COPP, WATCHET, SOMERSET.

LAMP-PILLARS,
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Our New and Choice Designs for the above, with prices, are forwarded to any part of the world on receipt of twelve stamps. Estimates for work at home or abroad.

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C. & W. WALKER'S
WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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SOLE PROPRIETORS AND MANUFACTURERS OF
WOLSTON'S CELEBRATED
TORBAY IRON PAINTS.
(ESTABLISHED 1851.)

These Paints have been for many years extensively used in Her Majesty's Royal Dockyards, Woolwich Arsenal, the Shorncliffe and Curragh Camps, War Departments, and Colonies, and are largely supplied to Railway, Harbour, and GAS COMPANIES, Shipowners, Engineering Establishments, Railway Carriage and Waggon Works, and the Paint Trade generally. They are the BEST PROTECTORS of IRONWORK, even arresting corrosion after it has set in; and their base being oxide of iron, they are free from those properties which make lead paints so destructive to ironwork. They do not scale or blister, are not affected by great heat, and are the only Paints which will resist the effects of sulphuretted hydrogen. Their DURABILITY and covering properties have borne the test of A QUARTER OF A CENTURY'S PRACTICAL TRIAL.

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Torbay Brown.	Torbay Red.
Dart Green.	Slate.
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Navy Green.	Lead.
Carriage Red.	Dark Stone.
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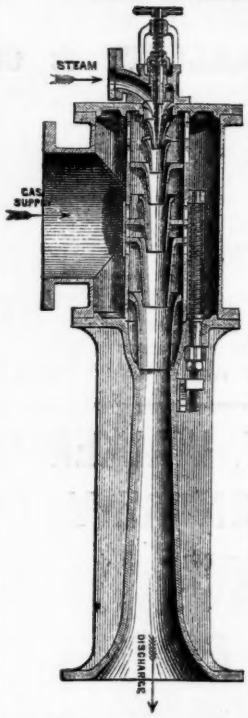

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Small Cost—Compactness—Perfectly Self-Acting—Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—No Extra Room Required—No Wear and Tear—No Noise—No Oscillation in Vacuum, or Back Pressure.

UPWARDS OF 200 IN USE.
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Combining small cost and thorough efficiency, with absence of any mechanical means and necessity of renewing the scrubbing material.

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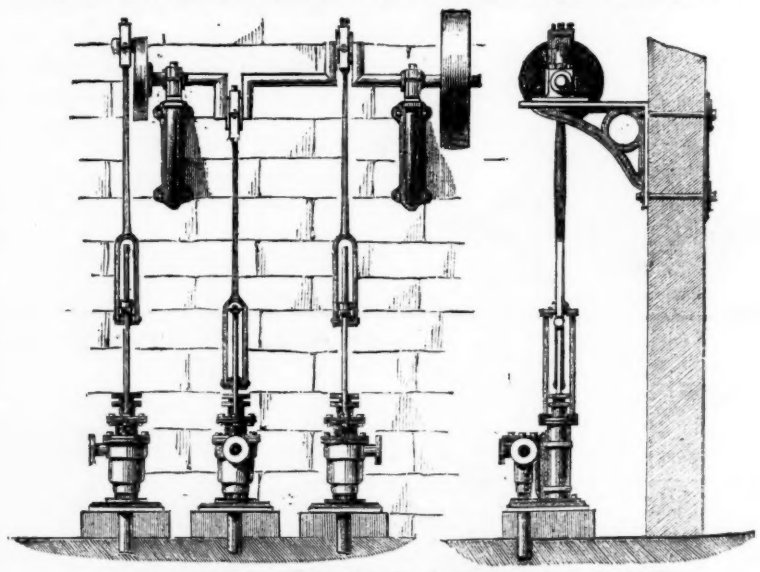

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This illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.

These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.
GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.
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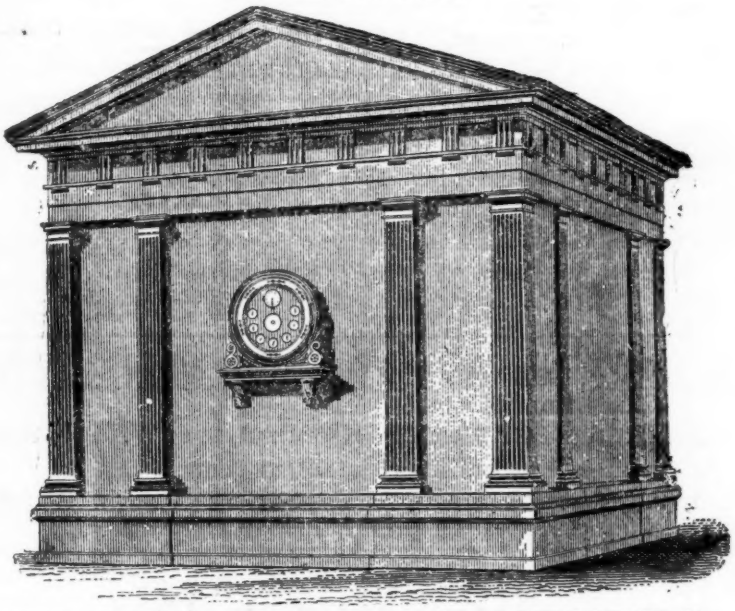

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CLAY RETORTS, FIRE-BRICKS, AND EVERY DESCRIPTION OF FIRE-CLAY GOODS

THOMAS LAMBERT & SONS

MANUFACTURE EVERY DESCRIPTION OF

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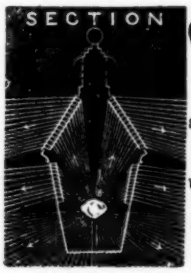

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LOTHIAN'S CANNEL
Yields 12,300 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL
Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

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Yields 13,320 cubic feet of 32·5-candle gas per ton.
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Are prepared to supply their
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This Coal yields 11,000 cubic feet of gas and 13½ cwts. of coke per ton.
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Cubic feet of Gas yielded per ton . . .	10,030
Illuminating power in sperm candles . .	15·4
Yield of coke per ton of good quality . .	13¾ cwts.

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POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17¼ candles.
One ton yields 12¼ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.
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The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

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Scotch Churls

PRESENT PRICE:
5s. 6d. per Ton at Pit.
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Cubic Feet.	Illuminating Power.	Coke (sup. qual.).
10,000 ..	20 candles. ..	12 cwt.

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COPPA COLLIERY, MOLD,
Beg leave to call the attention of Gas Companies to the superior quality of their
CANNEL FOR GAS-MAKING PURPOSES.
This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.
Ports of shipment—Birkenhead or Connah's Quay.
Waggons supplied for delivery by railway to any part of England or Wales.
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GAS COAL & CANNEL.

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Has on hand a quantity ready for immediate delivery, and is prepared to contract for Supplies during the years 1876 and 1877.

Can strongly recommend his real OLD SILKSTONE GAS COAL, which will give, in regular work, 10,200 feet 16·6-candle gas, and 12 cwt. superior coke.

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STRONGLY RECOMMEND A TRIAL OF THEIR
CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

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REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

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THE DERBYSHIRE
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CAN OFFER A

GAS COAL

Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	10,775
Weight of coke in lbs. per ton of coal	1,465

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Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: CUSTOM HOUSE CHAMBERS, LEITH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.	Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	34·83
Value of 1 cubic foot of gas in grains of sperm	780	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	71 minutes.
Gravity of the gas (air = 1000)	596	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.	Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	33·09
Value of 1 cubic foot of gas in grains of sperm	878	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	67 minutes.
Gravity of the gas (air = 1000)	677	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company.

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Over 90,000 in action.

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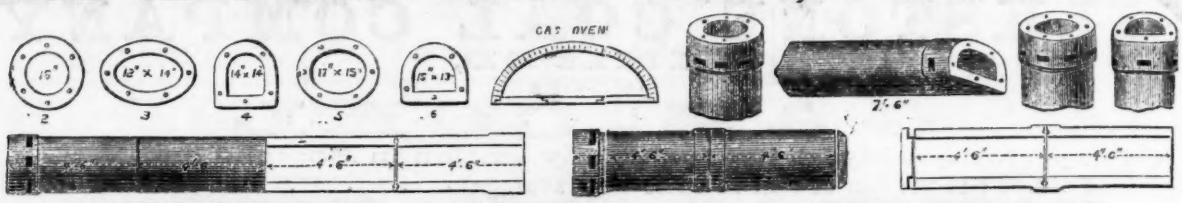

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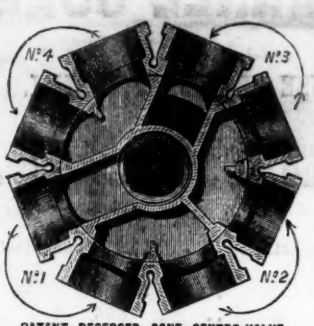

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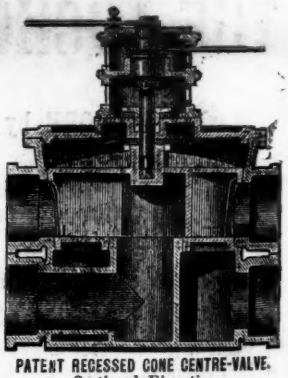

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